2014

ONTARIO CODE AND CONSTRUCTION GUIDE FOR HOUSING

Ontario

Ministry of Municipal Affairs and Housing

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Ontario

August 1, 2014

To: Code and Construction Guide for Housing Users

The Ministry of Municipal Affairs and Housing (MMAH) is pleased to introduce the official 2014 Ontario Code and Construction Guide for Housing.

Since 1990, the Code and Construction Guide for Housing has played an important role providing current, practical and accurate construction information to builders, building officials, designers, educators, students and others in the housing industry.

The 2014 edition of the Ontario Code and Construction Guide for Housing builds on our lengthy experience in providing relevant information to stakeholders. It is current up to the Ontario Regulation 332/12 of the Building Code and Supplementary Standards as amended by O. Reg. 368/13, and contains many new and unique features. It has been developed with input from stakeholders in the homebuilding and regulatory sectors.

Everyone benefits from an industry-wide commitment to increased consistency and understanding of Code requirements and better building practices for new homes, including: new home buyers, builders and building officials.

We thank our industry stakeholders who provided their time and technical expertise to develop supportive materials that are an integral part of that effort.

Sincerely,

Brenda Lewis
Director
Building and Development Branch
Ministry of Municipal Affairs and Housing

Additional Copies

For additional copies of the 2014 Code and Construction Guide for Housing, please contact:

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Online at www.publications.serviceontario.ca
By phone:

- o 416 326-5300
- o 1 800 268-7095 TTY Toll-free across Ontario
- o 1 800 668-9938 Toll-free across Canada

Code Information

Staff in the Building and Development Branch of the Ministry of Municipal Affairs and Housing provide Building Code information to the building industry, building officials and the public. For general information, please call (416) 585-6666 or to submit a question online go to: http://www.obc.mah.gov.on.ca

Construction Information

This publication serves as an information guide to the typical applications of the Building Code to housing construction in Ontario.

The Code and Construction Guide for Housing has been prepared for information purposes only. Reference should always be made to the *Building Code Act, 1992* and the Building Code (Ontario Regulation 332/12 as amended by Ontario Regulation 368/13) which are the authoritative sources of information on the Building Code's construction requirements. Accordingly, this publication should not be relied upon as a substitute for legal or design advice, and the user is responsible for how the publication is used or applied.

For the authoritative text of the *Building Code Act, 1992* and the Building Code, see the official version available on the government's legislative portal www.e-laws.gov.on.ca. Copies of the official compendium edition of the Building Code are available from ServiceOntario Publications. The Ministry of Municipal Affairs assumes no responsibility for errors or oversights resulting from the information contained herein.

Commencement and Transition

The 2012 Building Code was enacted by Ontario Regulation 332/12, which generally came into force on January 1, 2014. This publication is based on the 2012 Building Code, up to and including the amendment document Ontario Regulation 368/13 which comes into force on January 1, 2015.

Copyright

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Steering Committee

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PREFACE

The 2014 Code and Construction Guide for Housing does not address:

- additions to existing buildings
- renovations to existing buildings
- heritage buildings
- cottages
- multiple storey basements
- change of use
- sprinkler systems
- fire alarm systems
- structural design outside the scope of Part 9 of the Building Code.

The information in the 2014 Code and Construction Guide for Housing reflects, for the most part, the requirements in Part 9 of the Building Code. It deals primarily with the minimum mandatory requirements for typical house construction. It also includes a number of features such as better building practices and building insights not addressed through Code requirements.

The scope of the 2014 Code and Construction Guide for Housing is restricted to detached, semi-detached and row houses without shared egress and where there is no dwelling unit above another. The requirements for buildings with basement dwelling units with separate or shared egress are beyond the scope of this publication.

The Construction Guide is an important part of a continuing effort to provide current, practical, and helpful building construction information to the building industry: builders, inspectors, plan examiners, engineers, architects, designers, site superintendents, and other industry representatives.

The 5th Edition of the Code and Construction Guide for Housing incorporates the 2012 changes to the Building Code and amendments filed up to 368/13 that apply to housing. Many of these have been illustrated and have been added to the large number of existing requirements illustrated in earlier editions.

The objective-based format of the 2012 Building Code promotes innovation and flexibility in design and construction. The Code continues to contain prescriptive requirements known as 'acceptable solutions' that serve as benchmarks for evaluation.

The Ministry of Municipal Affairs and Housing and its partners are committed to continuous improvement in the quality of the 2014 Code and Construction Guide for Housing. As a result of the many suggestions made by you, we have included extra span tables, new insights, worked examples and many new figures that continue to illustrate and interpret Building Code requirements.

This document is intended to help the industry to understand construction methods and to help avoid costly repairs. Our common goal is to promote quality built homes.

INTRODUCTION

The 2014 Code and Construction Guide for Housing presents the 2012 Building Code requirements for single detached, semi-detached and row housing in plain language with self-explanatory illustrations.

The Construction Guide continues to include examples of better building practice which may exceed minimum Code requirements. These examples are based on industry research, documented evidence and manufacturers' recommendations.

In all cases, the methods of construction presented in the Construction Guide represent means of complying with Code requirements, subject to governing limitations and assumptions. The user is responsible for evaluating the applicability of these illustrated methods to the design and construction of all housing. Section 8 of the Building Code Act, 1992 requires the Chief Building Official to issue a building permit, unless the circumstances set out in Section 8 apply.

STRUCTURE OF THE 2012 BUILDING CODE

The provisions of the Building Code now relate to a discrete set of objectives and functional statements. Together, these establish the intention of the Code. Two paths are now available for the builder or designer to demonstrate Code compliance. The first is "acceptable solutions", the traditional path that requires design and construction to comply with prescriptive provisions that are found in Division B of the Code. The second path, "alternate solutions", that is now available, allows builders and designers to demonstrate compliance to the performance objectives and functional statements of the Code's Division A.

Division C is the administrative section and as such, it defines the terms for compliance with the Code. Namely drawings, submissions, inspections etc., Division C also contains a section on proposing alternative solutions, which represents the second path of compliance.

SUGGESTIONS

Suggestions regarding this publication are welcome. If you feel that areas are missing, unclear or incorrect, please forward your suggested improvement by completing the 2012 Building Code Change Request Form that is included in this section, along with Guidelines for Requesting Changes to the Building Code.

Publication Feedback
Code and Construction Guide for Housing
Ontario Ministry of Municipal Affairs and Housing
Building and Development Branch
2nd Floor, 777 Bay Street
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HOW TO USE THIS GUIDE

This publication consists of two parts:

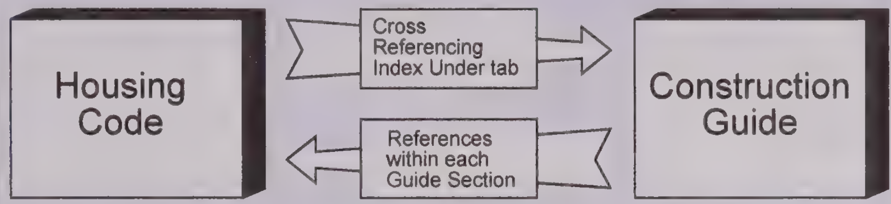
- Construction Guide
- "Building Code for Housing"

The Construction Guide consists of 16 chapters corresponding to various parts of the constructed house and presented in construction sequence. These chapters, sections and sub-sections are outlined in the Table of Contents.

The "Building Code for Housing", presented in this publication, is a convenience document only and includes excerpts from the 2012 Building Code which pertain to houses within the scope of the Construction Guide. The 2012 Building Code is the legal reference in the province and "Code" in this guide refers to the 2012 Building Code.

For users familiar with the Building Code, a cross-referencing appendix has been provided which relates "Building Code for Housing" articles to their counterparts in the Construction Guide by page number.

Where illustrations have been provided, an asterisk (*), appears beside the article. Figure A shows how to go from the Code to the Guide and vice versa. It is important to note that illustrations represent 'typical' details and are not intended to limit alternative means of meeting Code requirements. Figure B shows the relationship between scheduled inspections and the chapters in the construction guide. You may want to refer to these chapters prior to each inspection.



Housing Code is an extract from the Building Code without modification

Guide text and figures

- Simple language Code interpretation with illustrations and information beyond the scope and requirements of the Code
- Code sentences and tables may appear here more than once as references

Figure A
Relationship Between Housing Code and Guide

Relationship Between Scheduled Inspections and Construction Guide Chapters	
INSPECTIONS	**GUIDE CHAPTERS**
EXCAVATION	Chapter 2 - Foundations
FOOTINGS AND FOUNDATIONS	Chapter 2 - Foundations
FRAMING	Chapter 3 - Floor Framing Chapter 4 - Room and Space Dimensions Chapter 5 - Means of Egress Chapter 6 - Fire Saftey and Sound Control Chapter 7 - Wall Systems Chapter 8 - Roofing Chapter 9 - Windows and Skylights
INSULATION	Chapter 10 - Fireplaces, Chimneys and Flues Chapter 11 - Mechanical Systems Chapter 12 - Plumbing and Electrical Facilities Chapter 13 - Energy Efficiency, Air and Vapour Barriers
INTERIOR AND EXTERIOR FINISHES	Chapter 14 - Interior Finishes Chapter 15 - Exterior Finishes Chapter 16 - Garages, Carports, and Decks

Figure B
Relationship Between Inspections and Guide Chapters

METRIC CONVERSIONS

Metric units represent official Code requirements. Imperial equivalents have been converted from the metric units for user convenience, but have no legal basis.

Nominally converted dimensions occur in such cases as lumber and masonry. For example, 38 mm x 89 mm lumber (actual size) has traditionally been given the nominal size of 2" x 4", but has been indicated as 2 x 4 in this Guide. Similarly, a 190 mm masonry unit (actual size) is given the nominal size of 8", and is indicated as such. Remember that in all cases, the metric measurements govern.

The 2012 Ontario Building Code updated the spacing of structural elements from 300 mm, 400 mm, and 600 mm o.c to 305 mm, 406 mm, and 610 mm o.c. to better align with the imperial measurements of 12", 16", and 24", respectively, that were used in the original structural testing.

CONVENTIONS

Through this publication, a number of helpful features have been added to the Guide and are described in the following columns.

Shaded Areas in this Guide

Where building practices are not specifically required by the Code, or where insight is provided above and beyond that found in the Code, these are indicated by shaded areas. Additional considerations not addressed by the Code may also be found in unnumbered subsections. Code requirements always appear without shading and in numbered subsections.

Looking Back

This symbol is used whenever it is necessary to return to an earlier part of the Housing Guide to check Code requirements

Better Building Note

Better building practice is recognized by this symbol throughout the Guide. It must be emphasized that the recommendations found within a better building note are not required by the Code. The building practices addressed in these notes are intended to avoid commonly occurring problems and costly repairs in housing.

WORKED EXAMPLE

This symbol is used when there is an example with a calculation and solution provided

Looking Ahead

This symbol indicates the need to look ahead at specific Code requirements which may be affected by decisions made at an earlier stage.

For example, the minimum amount of insulation needed should be checked before designing and building a wood frame wall, rather than discovering the wall is inadequate when the time comes to insulate it. Each Looking Ahead reminder explains where to look and why.

Guideline for Requesting Changes to the Building Code

Request a Code Change

The Building Code improves with each edition thanks to the contributions of building officials, designers, builders, contractors, product manufacturers, researchers, building owners and the public. Typical changes accommodate new materials, systems and building design, clarify requirements, or update references to standards.

The Building Code is a regulation made under the Building Code Act, 1992. Given the joint Federal/Provincial/Territorial Code development process, changes developed by CCBFC for the mNBC and the mNPC are considered for inclusion in Ontario's Building Code. Suggestions for changes to the Building Code made by members of the public may also be considered. Potential changes to the Building Code are generally developed following a public consultation process and review by a Building Code technical committee.

Suggestions to improve the Building Code may be submitted to the Building and Development Branch of the Ministry of Municipal Affairs and Housing. The points that follow should be considered in developing a request for a Building Code change.

- **Clarity**
  Code change requests should clearly identify the specific change being proposed, current Code provisions that would be affected by the change, and the rationale for proposing the change. Proposed language for new Code provisions is helpful.

- **Supporting Documentation**
  Code change requests should be accompanied by sufficient documentation to support the need for the change. Documentation may include research, testing results, statistics, case studies, etc

- **Cost/Benefit Analysis**
  Code change requests should include information on implementation costs and the benefits likely to be achieved.

- **Assessment of Conformance**
  Code change requests may not be viable if there are no practical means of assessing conformance with the proposed new requirement. Requests should consider whether there are existing tools or models that can be used to assess the conformance of designs or construction with the requirements of the proposed Code change.

  Requests also need to consider whether the implementation of Code changes would have implications for enforcement bodies.

- **Timing**
  Although requests for changes to the 2012 Building Code can be made at any time, it is likely that most changes will be considered for inclusion in the next edition the Building Code. However, "interim" Code changes to the 2012 Code are possible.

Objectives

The objectives of the Building Code's requirements ("acceptable solutions") are set out in Division A. Code change requests should link proposed changes to one of the Code's stated objectives. The addition of a provision that cannot be linked to one of the currently stated objectives would require the addition of new objectives.

Focus on Generic/Widespread Issues

The Building Code's standards are of general application and it is therefore impractical for the Building Code to deal with specific products or with situations that arise only rarely.

However, innovative products that are not yet covered by standards or mentioned in the Codes are not necessarily excluded from use. Current administrative procedures to enable the use of innovative products are listed in Division C, and include Alternative Solutions, the Building Code Commission, the Building Materials Evaluation Commission and Minister's Rulings.

The attached form should accompany requested changes, although its use is not mandatory provided the criteria stated above are considered. Where the form does not provide sufficient space for the information you wish to include, you are encouraged to attach additional pages as necessary.

Additional electronic copies of the Building Code change request form may be obtained from the Building Code website at:

www.ontario.ca/buildingcode

2012 BUILDING CODE CHANGE REQUEST FORM

CONTACT INFORMATION:

Do you agree to permit sharing all information on this form with Building Code Review Committees and the Canadian Commission on Building and Fire Codes for the purposes of code development?

- ☐ YES
- ☐ NO

I am submitting this on behalf of:

- ☐ Myself, or
- ☐ Organization: ____________________

Your Title: ____________________

Your Name: ____________________

Address: ____________________

City: ____________________

Province: ____________________

Postal Code: ____________________

Telephone: ____________________

Facsimile: ____________________

Email: ____________________

Your function:
(if submitting on behalf of yourself)

- ☐ Builder / Contractor
- ☐ Building Official
- ☐ Building Owner / Manager
- ☐ Designer / Architect / Engineer
- ☐ Home Owner / General Public
- ☐ Supplier / Manufacturer
- ☐ Other: ____________________

CODE CHANGE REQUEST:

☐ To an existing code provision: ____________________
Code Reference of the Requested Change:
Division, Part, Section, Subsection, Article, Sentence, etc.eg: Div. B, 9.32.3.5.(1)

☐ Add a new code provision

Have you forwarded this change to the Canadian Commission on Building and Fire Codes as a proposed amendment to the model National Building or Plumbing Codes?

- ☐ YES
- ☐ NO

Personal information provided on this form is collected under the authority of the Building Code Act, 1992 and will be used for the purpose of code development. Please direct any questions about the collection of information by mail to the following address:
Manager, Code Development, Legislation and Appeals
Building and Development Branch, 777 Bay Street 2nd Fl., Toronto, Ontario M5G 2E5
telephone: (416) 585-6666
or by facsimile at: (416) 585-7455

REQUESTED CHANGE/ADDITION: What wording do you propose for the change?	
PROBLEM: Why should the existing provision be revised? If requesting an addition to the Code, what is missing?	
JUSTIFICATION/EXPLANATION: How does the requested change address the problem?	
OBJECTIVE(S): Which of the Code's objectives does the requested change address? See Part 2 of Division A of the Building Code for the list of objectives.	
COST/BENEFIT IMPLICATIONS: Will the change entail any added costs? Will it provide benefits that are measurable?	
ENFORCEMENT IMPLICATIONS: Can the requested change/addition be enforced by the infrastructure available to enforce this Code? Will its enforcement require an increase in resources?	
OTHER COMMENTS: For example, identify other Code requirements affected by the requested change, etc.	
ATTACHED SUPPORTING MATERIAL:	

Present only one change request per form. Duplicate the form as necessary. You may attach additional pages or use any other format to submit your request as long as all the information indicated above is included. Mail or fax to:
Director, Building and Development Branch
Ministry of Municipal Affairs and Housing
777 Bay Street 2 nd Floor
Toronto, Ontario M5H 2E5
Fax: (416) 585-7455

Construction Guide for Housing

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16 Garages, Carports, and Decks

1 START-UP

This chapter provides information essential to the successful start-up of the construction project. It also reviews the scope of the Building Code as well as a number of general Code requirements that should be understood before construction begins. These general requirements pertain to, for instance, the proper installation of materials, appliances, systems and equipment. They also refer to other design and construction considerations including climatic data.

Finally, a detailed discussion of the plans, permits, and inspections process is included.

KEY POINTS

- This document focuses on new home construction within the scope of Division B, Part 9; namely, dwelling units that are three storeys or less and with a building area of 600 m^2 (6460 ft^2) or less and where there is no dwelling unit above another.
- Both a performance and a prescriptive Code compliance path are available to builders and designers as outlined in Division A of the Code.
- All code references in the Guide are to Division B unless otherwise noted.

ADMINISTRATION, COMPLIANCE PATHS, AND DEFINITIONS

BUILDING CODE REFERENCES

DIVISION A

1.1.1.1.	Scope of Division A
1.1.1.2.	Scope of Division B
1.1.1.3.	Scope of Division C
1.2.1.1.	Compliance with Division B
1.4.1.2.	Defined Terms

DIVISION B

1.3.1.1.	Effective Date

DIVISION C

2.1.1.1.	Documentation
2.1.1.2.	Tests

Ontario's Building Code is governed by the provisions of the Building Code Act. The Act is intended to enforce a minimum level of health and safety in all buildings, including housing. The Act and Regulations may be accessed online at no cost from the Service Ontario e-LAWS website (http://www.e-laws.gov.on.ca/). The compendium edition of the 2012 Building Code containing the Building Code Act, Building Code (O.Reg 332/12), Supplementary Standards, Appendix Notes, imperial equivalents and index is available through Service Ontario Publications.

As introduced in the Preface of this Guide, the 2012 Building Code has been revised and reformatted to promote innovation and flexibility in design and construction. The Code is structured as an objective-based Code into three main components: Division A, B and C. This Guide will focus on illustrating the prescribed Acceptable Solutions of Division B that comply with the new performance objectives and functional statements that are described in Division A and assigned in Supplementary Standard SA-1.

A number of definitions are provided for words and phrases used in the Code. These definitions are important for the proper interpretation of the Code and should be carefully understood and distinguished from definitions that are perhaps more common. The definitions are found in the Code portion of this publication in Division A.

For your convenience the imperial equivalents that are published in the compendium version of the Building Code have also been provided. In some cases, charts from the Building Code have also been presented in this document in both metric and imperial measures. However, in all cases, the metric measurements govern. Refer back to the Preface for the detailed conversion protocol used throughout the Guide.

Registration and Enrollments

The Building Code Act requires all builders and vendors to be registered under the Ontario New Home Warranties Plan Act. All new homes for sale must be enrolled upon the issuance of a building permit. Failure to register is a contravention of the Ontario New Home Warranties Plan Act; the act is administered by the TARION Warranty Corporation. For more information please see www.tarion.com

Defined Term
dwelling unit:

a suite operated as a housekeeping unit, used or intended to be used as a domicile by one or more persons and usually containing cooking, eating, living, sleeping and sanitary facilities.

GENERAL REQUIREMENTS

BUILDING CODE REFERENCES

DIVISION A

1.1.2.1.	Application of Parts 1, 7 and 12
1.1.2.4.	Application of Part 9
1.1.3.1.	Building Size Determination of Building Divided by Firewalls
1.1.3.2.	Building Size Determination of Building Divided by Vertical Fire Separations
1.2.2.1.	Characteristics of Materials, Appliances and Equipment
1.2.2.2.	Used Materials, Appliances and Equipment

DIVISION B

1.1.2.1.	Climatic and Seismic Design Values
1.3.1.1.	Effective Date
1.3.1.2.	Applicable Editions
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9.10.4.1.	Mezzanines not Considered as Storeys

DIVISION C

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1.2.2.2.	Restriction for General Review
1.2.2.3.	Demolition of a Building
1.3.1.2.	Applications for Permits under Section 8 of the Act
1.3.1.3.	Period Within Which a Permit is Issued or Refused
2.3.1.1.	Application Fee

A number of general Code requirements apply to housing and should be carefully reviewed before beginning design or construction. The most important of these are discussed on the pages which follow.

Application

Part 9 of the Code applies to housing and small buildings, provided they are of 3 storeys or less in building height and have a building area not exceeding 600 m² (6460 ft²). This Guide is limited to the Part 9 provisions for single, detached, semi-detached and row housing types which are site built. Further, this document only applies to dwelling units where there is no dwelling unit above another.

Figure 1.1 shows how building area and building height are determined. These are both defined terms under the Building Code.

Materials, Appliances, Systems and Equipment

The Code requires that all materials, appliances, systems and equipment must be properly installed and possess the necessary characteristics to perform their intended function. Many standards govern these products and their installation, but they can not always address every possible case. For this reason, it is important to evaluate the intended functions of products prior to selection and installation. In the case of used materials, appliances and equipment, these may be reused provided they meet the requirements for new products and are satisfactory for their intended use. See the end of this chapter for a more detailed explanation of evaluation procedures.

Design Data

The design data includes climatic and seismic data and is found in Supplementary Standard SB-1 referenced by the Code. Check with the local building department for sites not contained within the table of design data.

Design and General Review

Typically, dwelling unit construction as described in this Code and Guide does not usually require design and general review by an architect or professional engineer. However, there may be specific cases prescribed in the Code where professional involvement or competent design is required.

Within the scope of Part 9, design may be performed by qualified designers, professional engineers or architects. Check with the local building department for any cases which are not addressed within the Code to determine whether design and general review is needed.

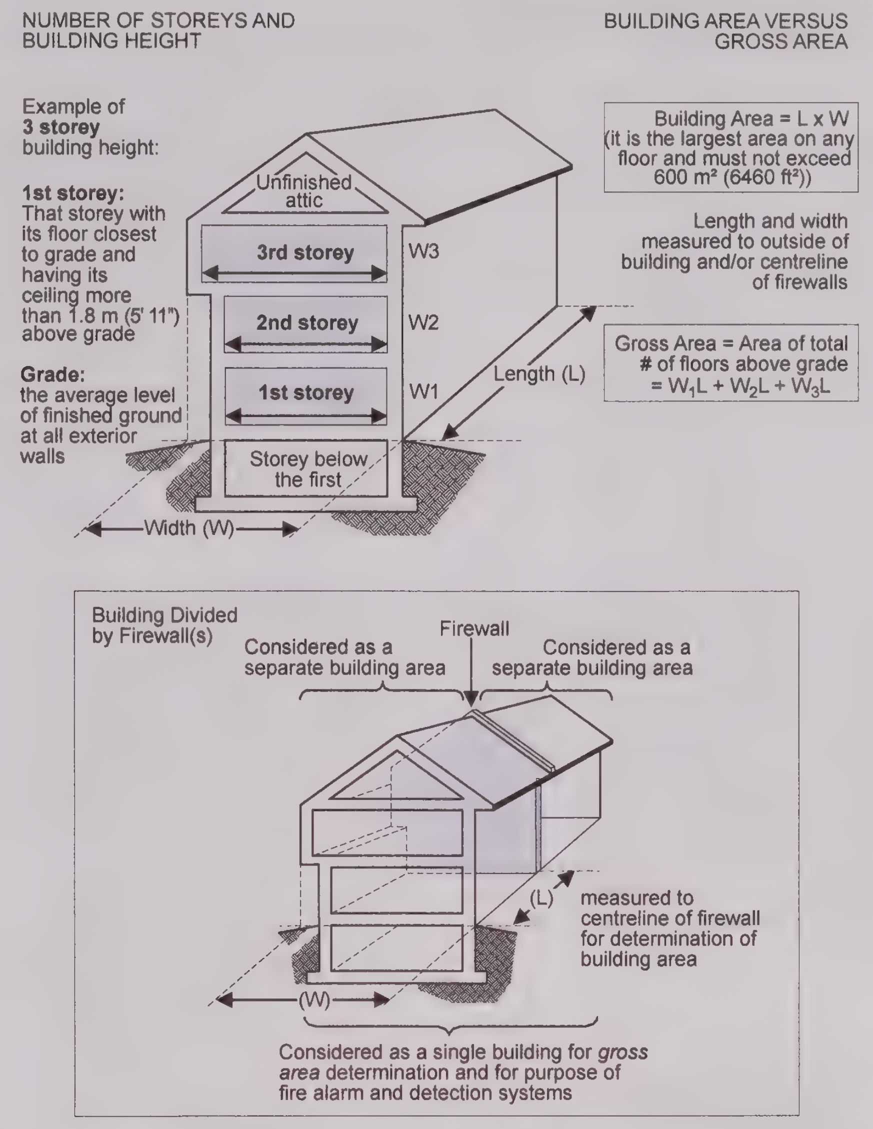

Figure 1.1
Building Size Determination

Referenced Documents

The referenced documents, such as standards, that are listed in the Code form part of the regulation and must be adhered to. Referenced documents may be issued by the Ministry or other agencies such as the Canadian Standards Association; in all cases all referenced documents form part of the Code requirements and regulation. A complete list of referenced documents can be found in Part 1 of Division B. Where a requirement within a referenced document conflicts with a specific Code requirement, the Code requirement always governs. This is an important point to note, particularly at the design stage.

PLANS, PERMITS, AND INSPECTIONS

BUILDING CODE REFERENCES

DIVISION C

1.3.1.1.	Requirement for Permits
1.3.1.4.	Permits Under Section 10 of the Act
1.3.1.5.	Conditional Permits
1.3.2.1.	Permit Posting
1.3.2.2.	Documentation on Site
1.3.3.2.	Conditions for Residential Occupancy
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1.3.5.5.	Orders
1.3.6.1.	Application
2.2.1.1.	Divisions
2.2.1.2.	Single Member

Normally plans and technical drawings are required for the issuance of a building permit. A permit is normally required for the construction or demolition of a building except in territories without municipal organization. The Code prescribes specific inspection requirements which are mandatory for all municipalities. Some municipalities engage in additional inspections. Contact your local building department for complete inspection requirements.

Looking Ahead

Chapter 6
Fire Safety & Sound Control

Siting of a building has many important implications in relation to fire safety requirements. Local by-laws may permit a new building to be located within a distance from the property line requiring restrictive fire separation measures. In some cases, these measures may prohibit the installation of windows on exterior walls adjacent to the property line.

Review the requirements outlined in Chapter 6 of this guide before siting any new building.

Plans and Permits

Plans and building permits are normally required for the construction of a new building. Applicants for building permits are also required to ensure compliance with applicable law such as municipal zoning by-laws made under the Planning Act or regulations made by a conservation authority under the Conservation Authorities Act. Severe penalties may result when approval is not sought and obtained. Check with the local building department for a complete list of required approvals prior to commencing any work. See the end of this document for an example of a Permit Application Form.

Plans usually form the basis of all applications for a building permit. Without plans and technical drawings, it is seldom possible to determine if the proposed design and construction conforms to specific Code requirements. Plans may also be required by local Conservation Authorities, and by local municipalities for zoning and planning approvals.

As a minimum, it is recommended to provide copies of an accurate site plan showing the location of the building on the property and in relation to all adjacent properties and buildings, along with a set of construction drawings comprising of:

- ☐ building elevations,
- ☐ technical drawings,
- ☐ sections and,
- ☐ where required, details of key elements.

The construction drawings should provide ample information for examination and review purposes.

For a detailed Plans Examination Checklist prepared by the Ministry of Municipal Affairs and Housing, please see the additional material at the end of this document.

The Code requires the posting and availability of specified site documents:

1. All permits must be visibly posted during construction.

2. A complete set of building permit documents issued by the building department must also be available on site at all times.

3. Any Minister's Rulings, including reference to Canadian Construction Materials Centre (CCMC) evaluations, and authorizations from the Building Materials Evaluation Commission, including specified terms and conditions, must be kept and maintained on site.

A person may occupy an incomplete building provided the building falls within the scope of the Code and the following are complete and, operational, inspected and tested where applicable:

- required exits,
- handrails and guards,
- fire alarm and detection systems,
- fire separations,
- water supply,
- sewage disposal,
- protection of foamed plastics,
- lighting and heating systems,
- required exhaust fume barriers,
- self-closing devices on doors between an attached or built-in garage and a dwelling unit,
- water systems,
- building drains
- building sewers,
- draining systems,
- venting systems, and
- the dwelling must conform to the Radon requirements of Article 9.1.1.7. of the Code.

INSPECTIONS

Inspections are required at critical phases of the building to determine if construction complies with the approved plans and related Code requirements. Once a building permit has been issued, it is the responsibility of the person named on the permit to notify the building official of the following progress:

a) commencement of building construction,

b) readiness to construct footings,

c) substantial completion of;

- the footings and foundations,
- ductwork and piping for heating and air conditioning systems,
- structural framing,
- insulation and vapour barriers,

d) commencement of the construction of;

- masonry fireplaces and chimneys,
- factory-built fireplaces and chimneys,
- stoves, cooktops, space heaters and add-on furnaces using solid fuels,

e) substantial completion of;

- fire separations and closures,
- fire alarm and detection systems,
- interior finishes,
- heating, ventilating, air-conditioning and air-contaminant extraction equipment,
- exterior cladding,
- fire access routes, and

f) completion and availability of drawings of the building as constructed.

Figure 1.2 indicates the typical steps in the plans, permits and inspections process. For a comprehensive recommended site inspection checklist which includes Code required inspections, the Ontario Ministry of Municipal Affairs and Housing has developed a detailed Building Code site inspection checklist that can be found in the additional materials at the end of this document. Using the list to confirm that all work required for each inspection has been completed may reduce unnecessary delays on site.

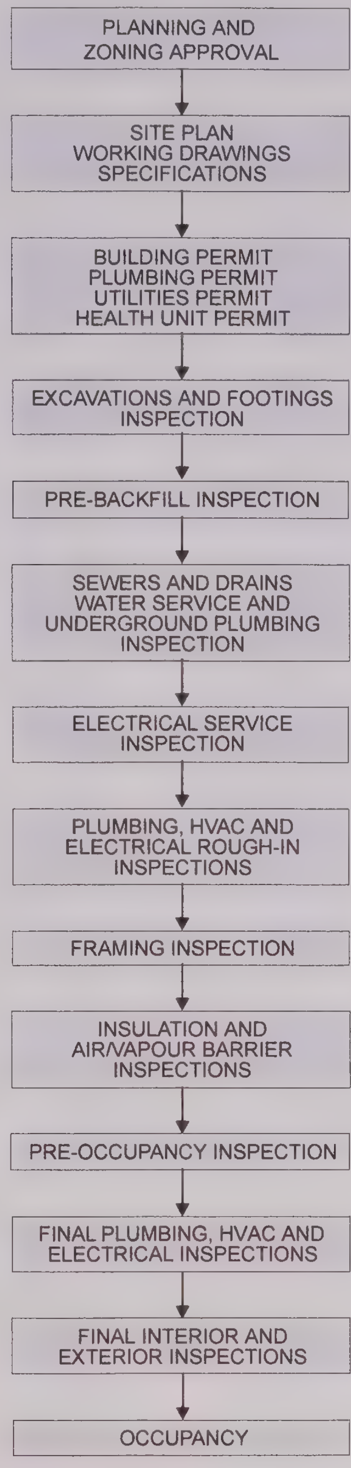


Figure 1.2
Plans, Permits, and Inspections

HEATING, VENTILATING, AND AIR CONDITIONING

BUILDING CODE REFERENCES

DIVISION B

6.1.1.1.	Scope
6.2.1.1.	Good Engineering Practice
6.2.1.2.	Design Indoor Air Temperatures
6.2.1.3.	Structural Movement
6.2.1.4.	Installation Standards
6.2.1.5.	Fireplaces
6.2.1.7.	Outside Design Conditions
6.2.1.8.	Installation - General
6.2.1.9.	Expansion, Contraction and System Pressure
6.2.1.10.	Asbestos
6.2.1.11.	Access Openings
6.2.4.1.	Application
6.2.4.3.	Construction and Installation of Ducts and Plenums
6.2.4.4.	Warm-Air Supply Outlets
6.2.4.10.	Clearances of Ducts and Plenums
6.2.4.11.	Exhaust Ducts and Outlets
6.2.4.12.	Make-up Air
6.2.4.13.	Supply, Return, Intake and Exhaust Air Openings
6.2.4.14.	Air Filters and Equipment
6.2.5.2.	Appliances Installed Outside the Building
6.2.9.1.	Piping Materials and Installation
6.2.9.2.	Insulation and Coverings
6.2.9.3.	Clearances
6.2.9.4.	Surface Temperature
6.2.9.5.	Protection
6.2.9.6.	Piping in Shafts
6.2.10.1.	Cooling Units
6.2.11.1.	Storage Bins
6.3.1.1.	Requirement for Venting
9.32.	Ventilation
9.33.	Heating and Air-Conditioning

The requirements for heating, ventilating and air conditioning systems, design and installation may be found in references noted above in the Code. The use of qualified contractors and certified equipment and materials may reduce the likelihood of violating specific Code requirements. Nonetheless, it is the responsibility of the builder to ensure that the Code requirements are satisfied. Chapter 11 of the Guide outlines the key requirements for heating, ventilating and air conditioning.

BUILDING MATERIALS, DESIGN, AND CONSTRUCTION CONSIDERATIONS

BUILDING CODE REFERENCES

DIVISION B

9.3.1.1.	General
9.3.1.2.	Cement
9.3.1.3.	Concrete in Contact with Sulfate Soil
9.3.1.4.	Aggregates
9.3.1.5.	Water
9.3.1.6.	Compressive Strength
9.3.1.7.	Concrete Mixes
9.3.1.8.	Admixtures
9.3.1.9.	Cold Weather Requirements
9.3.2.1.	Grade Marking
9.3.2.2.	Lumber Grades
9.3.2.3.	Machine Stress Rated Lumber
9.3.2.4.	OSB, Waferboard and Plywood Marking
9.3.2.5.	Moisture Content
9.3.2.6.	Lumber Dimensions
9.3.2.7.	Panel Thickness Tolerances
9.3.2.8.	Undersized Lumber
9.3.2.9.	Termite and Decay Protection
9.3.3.1.	Sheet Metal Thickness
9.3.3.2.	Galvanized Sheet Steel
9.4.	Structural Requirements
9.4.1.1.	General
9.23.1.1.	Limitations
9.23.2.1.	Strength and Rigidity
9.23.2.4.	Lumber
9.23.2.5.	Termite Protection
9.23.3.1.	Standards for Nails and Screws
9.23.3.2.	Length of Nails
9.23.3.3.	Prevention of Splitting
9.23.3.4.	Nailing of Framing
9.23.3.5.	Fastening for Sheathing or Subflooring

DIVISION C

2.1.1.1.	Documentation
2.1.1.2.	Tests
2.4.1.1.	Designated Bodies
2.4.2.1.	Criteria
2.4.3.1.	Interpretations by Minister

This section of the Guide is intended to explain Code requirements for building materials, design and construction considerations. Requirements for each of the subsections presented should be carefully checked at the design stage and prior to construction. Assistance in the interpretation of these requirements is available from local building departments.

BMEC and Minister's Rulings

In general, it is required that all materials, appliances, systems and equipment, including those which are not specifically addressed in the Code, be suitable for their intended purpose.

Where no recognized test procedures exist for a given material, appliance, system or equipment, approval for an alternative solution may be granted where it has the same level of performance with a similar material or system that is known to be acceptable.

Building materials, appliances, systems and equipment which do not comply with existing standards or Code requirements may be evaluated to determine if they possess the necessary characteristics for their intended use. Applications may be made in such instances to the Building Materials Evaluation Commission (BMEC) through the Building and Development Branch of the Ontario Ministry of Municipal Affairs and Housing. A fee for each application is normally required.

Where a BMEC authorization has been issued regarding the use of an innovative material, appliance, system or equipment - the approved can be used anywhere throughout Ontario provided the conditions and limitations stipulated in the authorization are met.

The Building Code also recognizes the Canadian Construction Materials Centre (CCMC) of the National Research Council of Canada as a designated body to evaluate materials. As such, the Minister may issue a Minister's Ruling to recognize a CCMC evaluation report but the Ruling can also impose terms and conditions to the evaluation report, including termination conditions.

Concrete

The requirements for concrete may be found in Subsection 9.3.1. of the Code. Except as otherwise specified, these provisions apply to all concrete referred to in the Code.

Lumber and Wood Products

Lumber and wood product requirements for construction may be found in Subsection 9.3.2. of the Code. It is important to check that all lumber specified in drawings and used for construction meets these general requirements as well as those cited in specific sections of the Code. Individual lumber and wood products which do not bear identification stamps should be carefully inspected to confirm their acceptability. All lumber and wood products should be properly stored and protected from moisture. Lumber with moisture content greater than 19% should not be used.

Metal

General requirements for all metal products used in housing are presented in Subsection 9.3.3. of the Code. Specific requirements are addressed throughout the Code where applicable.

General Structural Requirements

Where structural members, assemblies and connections conform to the requirements and limitations of the Code, competent or professional design is not required. Post, beam and plank construction, however, is no longer included within this Code and must be designed in accordance with the requirements of Part 4 of the Building Code.

Subsection 9.4.1. of the Code contains additional structural design requirements that should be considered prior to construction.

Wood Frame Construction

Wood frame construction has many general requirements that apply to the design and construction of floors, walls and roofs. These are presented in Subsections 9.23.1., 9.23.2. and 9.23.3. of the Code. References to these requirements in applicable chapters of the Guide have also been provided.

2 FOUNDATIONS

Foundations are intended to safely carry their own weight and the loads transferred to them from the buildings they support. Where foundations extend into the ground and enclose space such as basements and crawl spaces, they must also adequately resist any soil and water pressures acting against them. Foundations should not settle significantly or unevenly over time. They should remain unaffected by the freezing and thawing of soils.

The control of moisture in foundations has become especially important as basements have been transformed from cool, damp cellars to comfortable living spaces. The Code requires that water from the surface or a high water table is controlled to prevent leakage through walls and floors. It is also necessary to ensure that dampness from the soil is not allowed to wick through foundation materials.

Controlling heat flow through foundations has become increasingly important in response to demands for higher levels of energy conservation. Minimum thermal insulation requirements for foundations as prescribed in the Code help to provide energy efficient finished basement areas.

In some geographical areas, recognized problems involving radon and other potentially harmful soil gases entering the basement space require specific measures to be employed during construction. As a means of reducing potential risks in all housing, the control of air movement through the foundation is now recognized as both desirable and necessary.

Modern housing requires that all of these requirements for foundations are successfully integrated in design and construction. The sections which follow illustrate some of the methods for building foundations that perform as intended.

KEY POINTS

Foundations must be designed and constructed to fulfill the following functions:

- transfer the structural loads of the building to the surrounding soil;
- resist soil and water pressures;
- prevent exterior moisture (water and vapour) from entering the dwelling unit's basement;
- control the flow of heat and air from the interior of the dwelling unit; and
- control the flow of soil gases

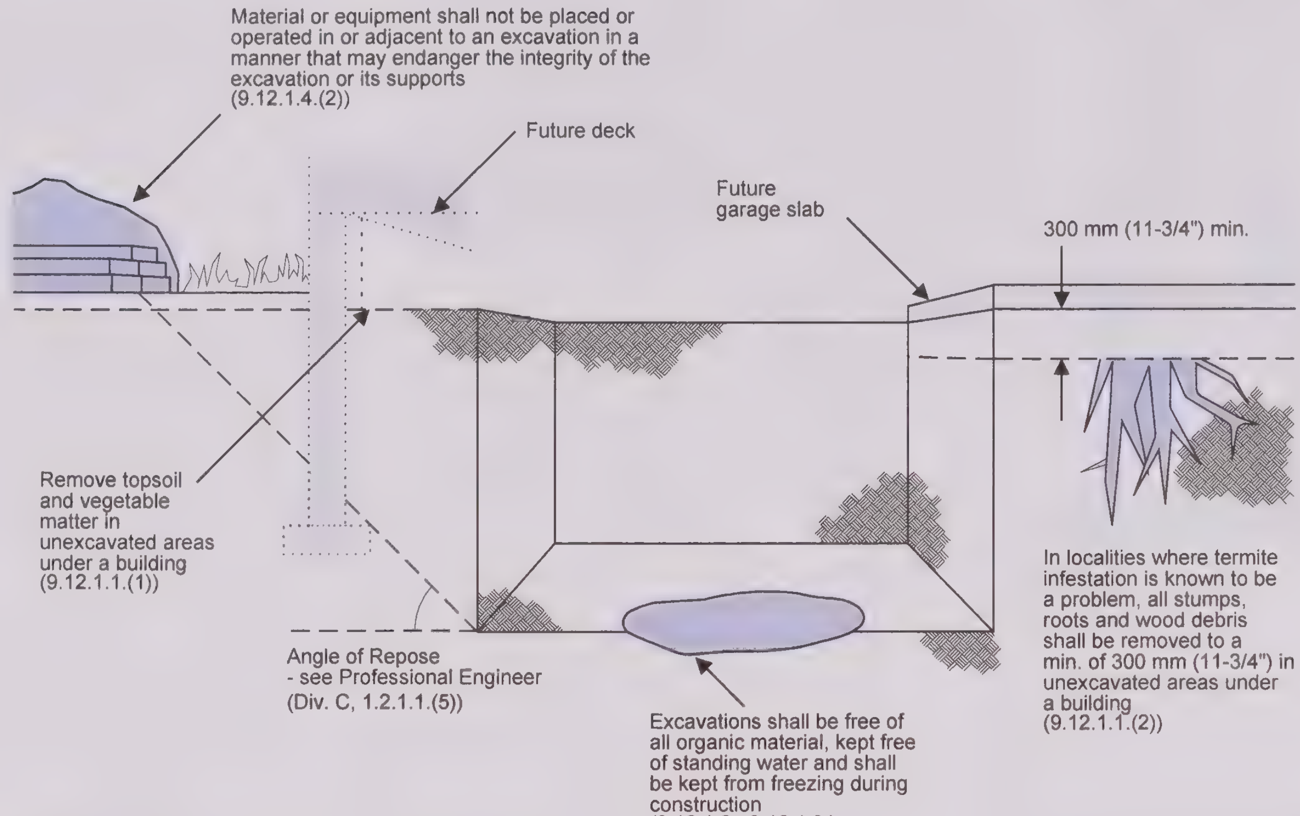


Figure 2.1
Removing Topsoil and Organic Matter

EXCAVATION

BUILDING CODE REFERENCES

DIVISION B

9.12.1.1.	Removal of Topsoil and Organic Matter
9.12.1.2.	Standing Water
9.12.1.3.	Protection from Freezing
9.12.1.4.	Precautions During Excavation
9.12.2.1.	Excavation to Undisturbed Soil
9.12.2.2.	Minimum Depth of Foundations
9.15.1.3.	Foundations for Deformation Resistant Buildings

DIVISION C

1.2.1.1.	Design

Most foundations involve the excavation of either soil or rock to some required depth. This section deals with some of the general requirements for excavations and specific requirements for the depth of excavation depending on the type of soil conditions and foundation type.

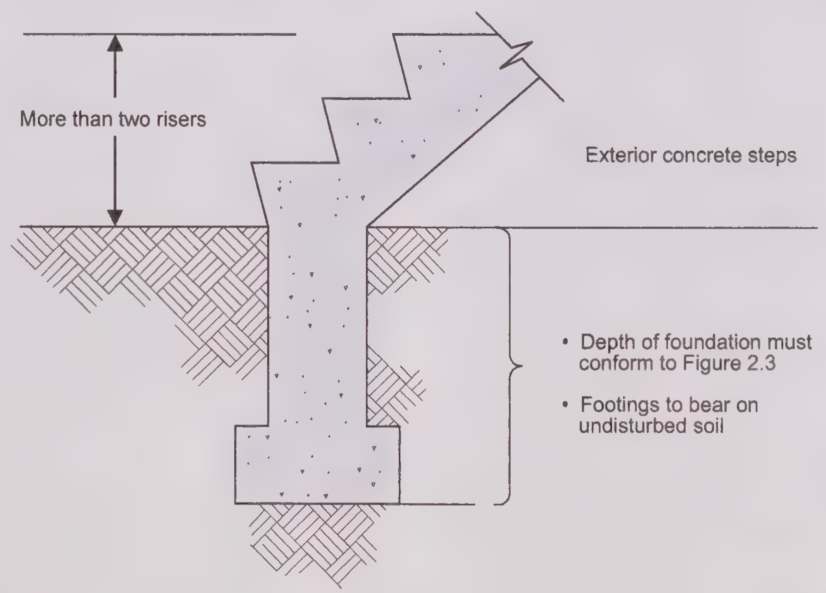


Figure 2.2
Foundations for Exterior Steps

(9.12.2.1.)
(9.12.2.2.)

General

Code requirements for excavation are illustrated in Figure 2.1. Topsoil and organic matter must be removed in all unexcavated areas under buildings. Where termites are known to occur, stumps, roots and other wood debris shall be removed from the soil to a minimum depth of 300 mm (11-3/4") under the building. The bottom of every excavation must be kept free of all organic material and standing water, and be protected from freezing throughout the entire construction period. All work must be carried out to prevent damage to adjacent property, structures, utilities and amenities. Safe construction practices to avoid injury to workers or damage to the excavation must be observed.

Depth of Foundation

All excavations for foundations shall extend to undisturbed soil. The minimum depths of foundations required by the Code are illustrated in Figures 2.2 and 2.3 along with a list of exempted structures.

Where foundations contain a heated basement or crawl space, no minimum depth is specified except for clay soils where a minimum depth of 1.2 m (3' 11") is needed to provide adequate bearing capacity for the foundation. In the case of foundations containing no heated space, minimum depths are specified for frost susceptible and poorly drained soils. The intent of the requirements governing unheated foundations is to ensure that the risk of frost heaving or adhesion freezing is reasonably minimized.

Soil Assessment and Identification

The relationship between a given basement system and the native soil around it is critically important. Proper identification of potential soil related problems at the design stage can help deliver a defect-free product.

Allowable Bearing Pressure

Soil Type and Condition	Maximum Allowable Bearing Pressure, kPa
soft clay	40
loose sand or gravel	50
firm clay	75
dense or compact silt	100
dense or compact sand, gravel, or stiff clay	150
till	200
clay shale	300
sound rock	500
	(9.4.4.1.)

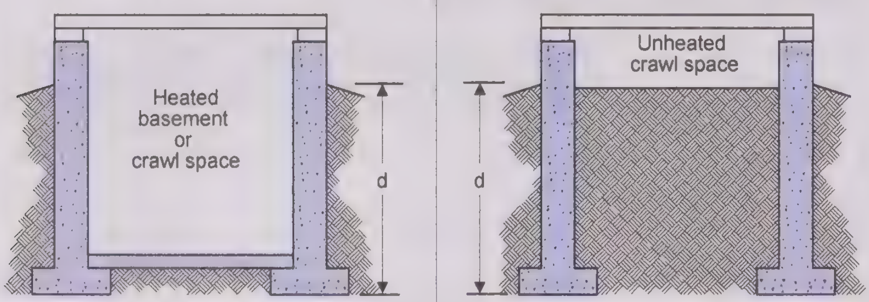
A variety of soil types exist in Ontario, from the rock of the Canadian Shield extending across the north of the province, to the mix of granular deposits of the Great Lakes lowlands. Identification and understanding of soil types is essential for a successful builder. Dr. Karl Terzaghi's 1943 book titled "Theoretical Soil Mechanics" is the basis for modern soil mechanics.

Successful builders usually follow normative approaches which rely solely on local experience and past performance on similar sites. In some cases, specific identification of soil types by area may be needed. Many municipal soil survey maps are often available through municipal engineering departments. Some of the necessary information can be obtained from these free resources, however, consultation with more advanced sources such as engineering reports or detailed geological data may help better understand soil conditions.

In general, there are two types of soils: fine grained and coarse grained. As a rule of thumb, coarse grained soils (e.g. gravels, and sands) are good foundation soils, and drain freely. Fine grained soils (silts, and clays) are typically weak founding soils, because they are easily disturbed, and drain poorly. These soils can also display a high potential for settlement problems. Builders may encounter unusual soil conditions which may require engineered foundation and/or engineered fill. Care and diligence should be taken in such situations, to avoid costly repairs and delays.

Footing design tables in Part 9 of Ontario's 2012 Building Code assume a minimum bearing capacity of 75 kPa. These tables should not be used for footings on soils weaker than this.

HEATED FOUNDATIONS | UNHEATED FOUNDATIONS



DEPTH OF FOUNDATION (d) – Heated: Good Soil Drainage	Heated: Poor Soil Drainage	Soil	DEPTH OF FOUNDATION (d) – Unheated: Good Soil Drainage	Unheated: Poor Soil Drainage
No Limit	No Limit	Rock	No Limit	No Limit
No Limit	No Limit	Coarse Grained	No Limit	Below depth of frost penetration
No Limit	No Limit	Silt	Below depth of frost penetration	Below depth of frost penetration
1.2 m (3' 11")	1.2 m (3' 11")	Clay	1.2 m (3' 11") but not less than depth of frost penetration	1.2 m (3' 11") but not less than depth of frost penetration

Where foundation insulation reduces the flow of heat beneath the footings, use the footing depth for unheated foundations.

EXCEPTIONS

The depths listed above do not apply to foundations for:

- Buildings not of masonry or masonry veneer construction
- Buildings built to structurally conform with CAN/CSA-Z240.2.1.
- Accessory buildings not of masonry veneer construction
- Accessory buildings, decks and other accessible exterior platforms:
  - not more than 1 storey in building height
  - not more that 55 m² (538 ft²) in building area
  - where the distance from the finished ground to the underside of the floor joists is not more than 600 mm (23-5/8")
- Decks and other accessible exterior platforms:
  - that do not support a roof
  - not attached to another structure unless problems associated with differential movement can be ruled out

Figure 2.3
Depth of Foundation (9.12.2.2.)

Poor Soil Conditions

When poor soil conditions (high ground water, unstable soils, clay, frost-susceptible soils), are encountered during excavation, the following measures are suggested:

1. continue to excavate until good soil is encountered;
2. perform a soil test on the native soil to determine foundation design requirements;
3. investigate the feasibility of installing a compacted granular layer to obtain the required bearing capacity; or
4. investigate more appropriate foundations (e.g. piers, piles, etc.).

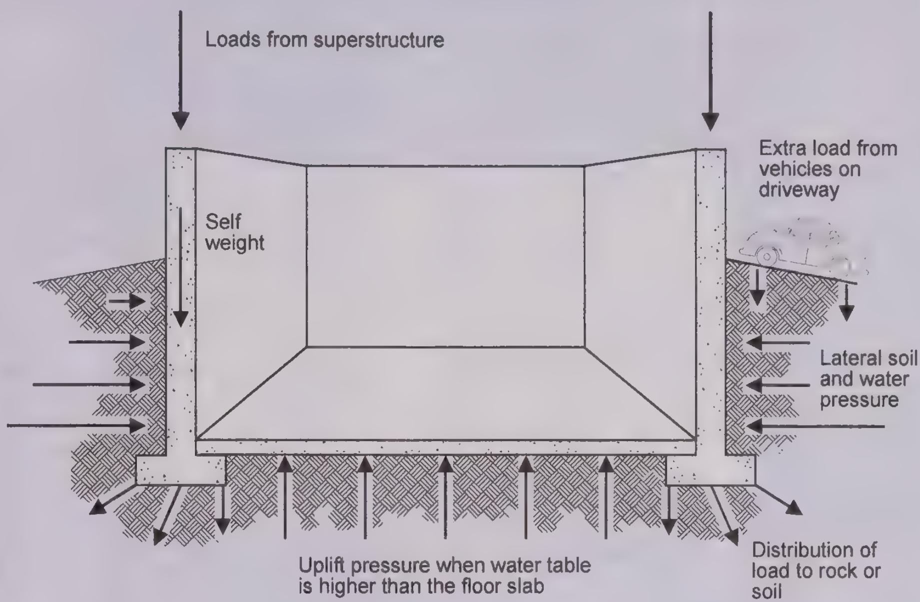
What to look for?

- garbage and debris
- organic soil
- water seeping in from the sides and bottom

Structural Considerations

Key Points

- **correct assessment of loads acting on foundations (e.g. building loads, soil, and water pressures)**
- **construction incorporating approved materials of the appropriate size and strength**
- **assembly of components to maintain structural integrity**
- **protection of materials for durability**
- **integration of structural considerations with other building requirements**



Buildings must be designed to safely resist the loads that act upon them. The weight of the building itself (dead load) and that of its occupants and contents (live load) in combination with the roof snow load represent the static gravity or downward loads. Wind and earthquake loads constitute the dynamic loads which may act on buildings. Soil and possibly water pressures exert lateral loads against below grade foundation walls.

Effects of surcharge should also be considered, i.e. extra load from vehicles on driveway adjacent to the house.

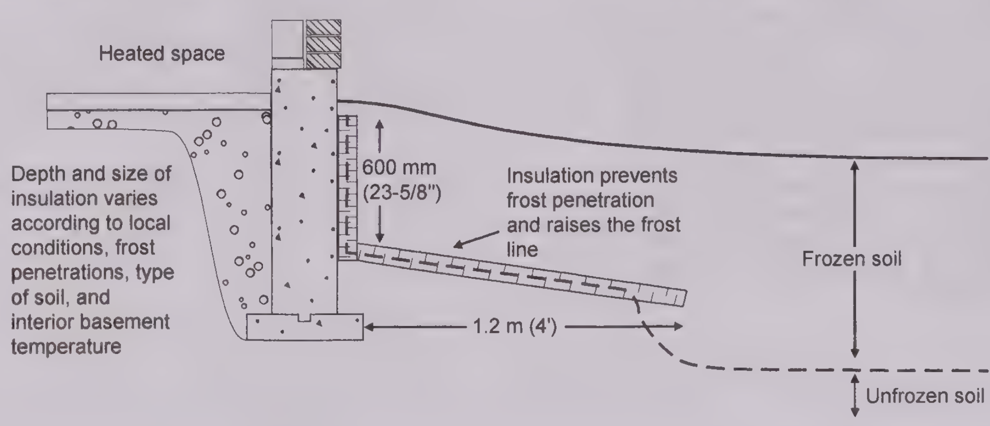
Foundations must be constructed with sufficient strength to resist any lateral loads while transferring gravity loads to the rock or soil. Materials used for construction must be approved and of the appropriate size and strength to perform as intended.

The structural performance of foundations affects the performance of the entire building. Successful buildings depend on sound, secure foundations. The sections which follow present the Code requirements for housing foundations.

Looking Ahead

Typical basement walk out, exterior insulation application.

Refer to 'Frost and Adfreezing' later in Chapter 2 and Chapter 13 for more information on frost protected footings.



FOOTINGS

BUILDING CODE REFERENCES

DIVISION B

9.4.4.1.	Allowable Bearing Pressures
9.4.4.2.	Foundation Capacity in Weaker Soil and Rock
9.4.4.3.	High Water Table
9.4.4.4.	Soil Movement
9.12.4.1.	Compacting or Filling With Concrete
9.15.1.1.	General
9.15.1.2.	Permafrost
9.15.2.1.	Concrete
9.15.3.1.	Footings Required
9.15.3.2.	Support of Footings
9.15.3.3.	Application of Footing Width and Area Requirements
9.15.3.4.	Basic Footings Widths and Areas
9.15.3.5.	Adjustments to Footing Widths for Exterior Walls
9.15.3.6.	Adjustments to Footings Widths for Interior Walls
9.15.3.7.	Adjustments to Footing Area for Columns
9.15.3.8.	Footing Thickness
9.15.3.9.	Step Footings

Footings are intended to transfer and distribute the loads they support so as not to exceed the safe loadbearing capacity of the soil or rock on which they bear. Footings must be provided, as shown in Figure 2.4, under walls, pilasters, columns, piers, fireplaces and chimneys.

Scope

Figure 2.5 on the following page indicates the scope for the application of the Code to footings and foundations. The sections which follow relate to foundations consisting of either concrete footings and solid concrete, insulated concrete forms or concrete block walls, or preserved wood foundation walls with wood or concrete footings, where the safe loadbearing capacity of the soil is equal to or greater than 75 kPa (10.9 psi). For conditions other than these, competent design according to Part 4 of the Code or consultation with your local Chief Building Official is required.

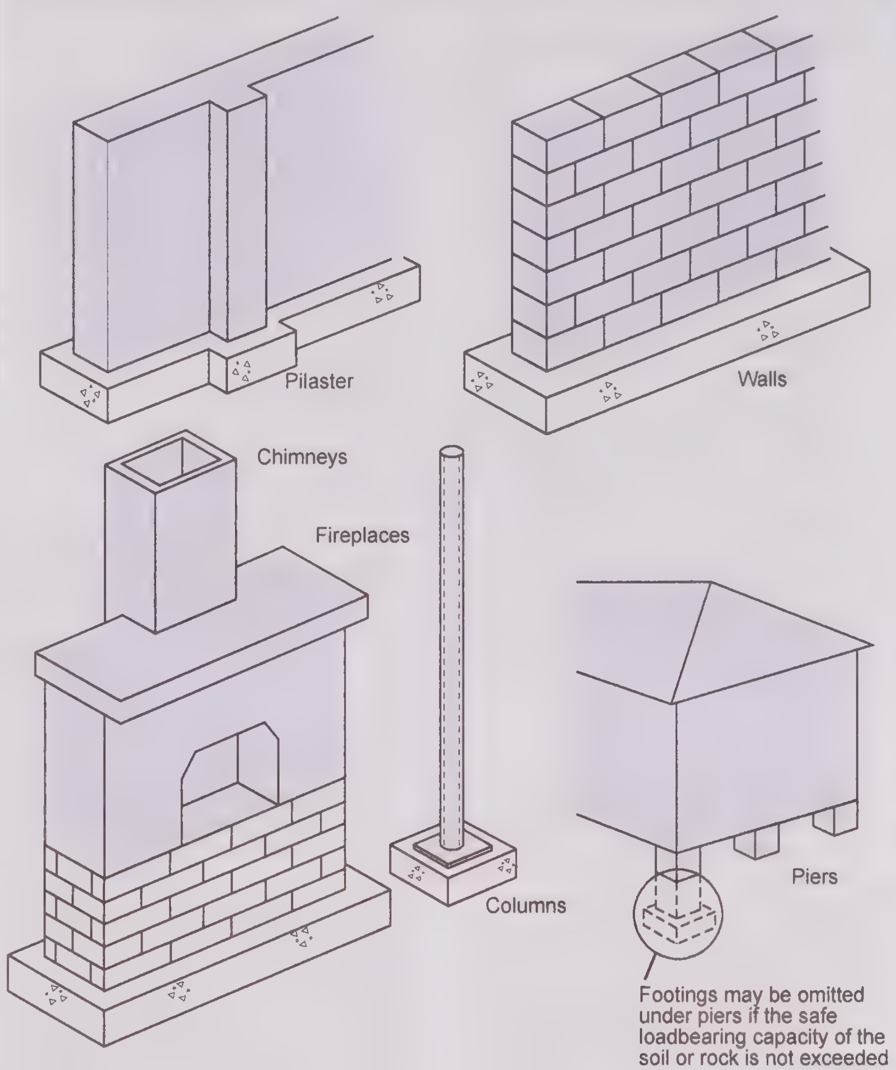


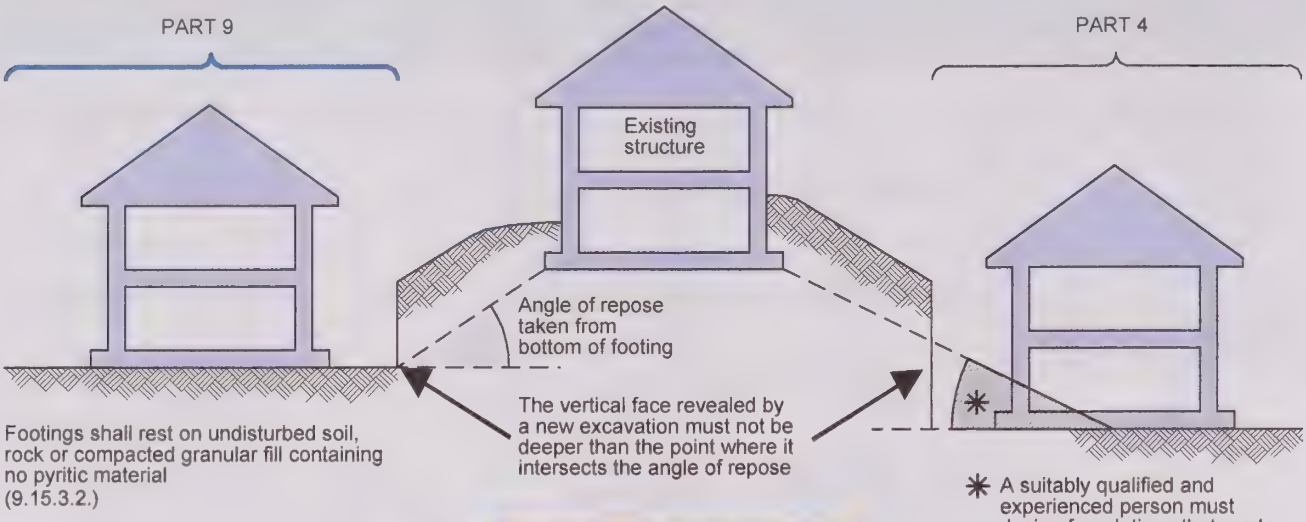
Figure 2.4
Where Footings Are Required (9.15.3.1.)

Application of Code Requirements to Footings and Foundations			
Basement Type	**Soil Condition**	**Code Reference**	**Applicable Code Sections**
SOLID CONCRETE FOOTING AND SOLID CONCRETE OR CONCRETE BLOCK WALLS	Allowable bearing pressure at least 75 kPa	9.15.1.	Section 9.15.
	Allowable bearing pressure less than 75 kPa	9.15.1.	Section 9.4. and Part 4
	Filled ground, peat, sensitive clay or permafrost	9.15.1., 9.15.2.	Section 4.2.
	Gravel, Sand or Silt AND the water table is within a distance below the bearing surface less than equal to the width of the footing	9.4.4.3., 9.15.3.4.	Section 9.4., 9.15. and Part 4
PRESERVED WOOD FRAME FOUNDATIONS	Allowable bearing pressure at least 75 kPa	9.15.1.	CAN/CSA-S406 Construction of Preserved Wood Foundations
	Allowable bearing pressure less than 75 kPa	9.15.1.	Part 4
	Filled ground, peat, sensitive clay or permafrost	9.15.1., 9.15.2.	Section 4.2.
	Gravel, Sand or Silt AND the water table is within a distance below the bearing surface equal to the width of the foundation	9.4.4.3., 9.15.3.4.	Section 9.4., 9.15. and Part 4
INSULATING CONCRETE FORM WALLS	Allowable bearing pressure at least 75 kPa	9.15.1.	Section 9.15.
	Allowable bearing pressure less than 75 kPa	9.15.1.	Section 9.4. and Part 4
	Filled ground, peat, sensitive clay or permafrost	9.15.1., 9.15.2.	Section 4.2.
	Gravel, Sand or Silt AND the water table is within a distance below the bearing surface less than or equal to the width of the footing	9.4.4.3., 9.15.3.4.	Sections 9.4., 9.15. and Part 4

Note: Allowable bearing pressure is defined as the maximum pressure that may be safely applied to soil or rock by the foundation unit considered in design under expected loading and subsurface conditions.

*75 kPa is approximately equal to 10.9 psi

Figure 2.5
Application of Code Requirements to Footings and Foundations (9.15.1.1.)



Material Undisturbed	Angle of Repose	
	Dry	Wet
Clay	40° to 50°	20° to 25°
Loam	40° to 45°	17° to 25°
Sand (Fine)	30°	25°
Sand (Coarse)	35°	25°
Gravel	35°	26°

Figure 2.6
Footing Limitations

Limitations and Assumptions

Application of the prescribed Code requirements for footings and foundations is based on the limitations and assumptions depicted in Figures 2.6 and 2.7. Where the maximum supported span of the floor joists exceeds 4.9 m (16' 1"), or the maximum live load exceeds 2.4 kPa (50 psf), footings must be competently designed according to 9.15.3.4.(2) or according to Part 4.2 of the Code (See Figure 2.12). The prescribed Code requirements are intended to deal with the majority of situations encountered in houses.

Where the foundation of a building is constructed below the level of the footings of the adjacent buildings and is within the angle of repose of the soil, the foundation is required to be designed by a suitably qualified and experienced person. See Figure 2.6.

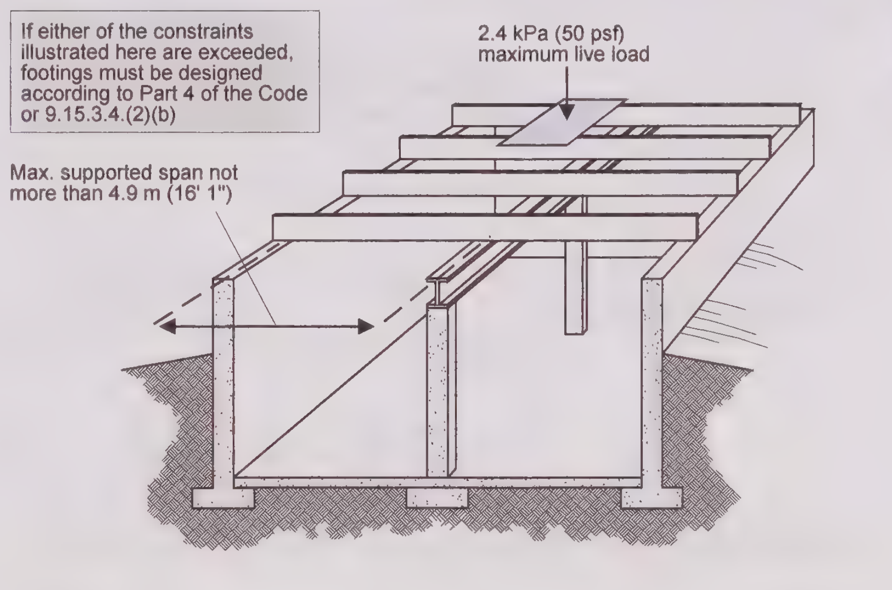


Figure 2.7
Maximum Live Load
(9.15.3.3.(1))

Looking Ahead

Refer to the 'Backfilling' section later in this chapter for more information on pyritic material.

FOOTING SIZES

Exterior and Interior Walls

Subject to the scope, limitations and assumptions for foundation loads in Articles 9.15.1.1., 9.15.1.2., and 9.15.2.4. footing sizes for exterior and interior walls are depicted in Figures 2.8, 2.9 and 2.10.

Footing sizes depend on the amount of load carried and the bearing capacity of the soil beneath them. The larger the load, the larger the footings required. Likewise, the lower the bearing capacity of the soil, the larger the footings required.

The minimum footing sizes prescribed by the Code are based on the building height and type of wall construction, either interior or exterior. To use the Figures 2.8 and 2.10 select the applicable building height and type of wall construction to determine the minimum footing size required.

The design capacity of the footing must not exceed the allowable bearing pressure of the soil it rests on. Where weaker soils exist within a distance equal to two footing widths beneath the footing, the design capacity of the footing must not exceed the minimum bearing capacity of the weaker soil. Refer to 9.4.4.2.

Minimum Footing Sizes Under Exterior Walls

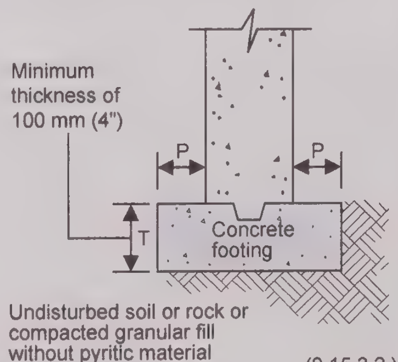
ABOVE GROUND EXTERIOR WALL CONSTRUCTION / BUILDING HEIGHT	1-Storey	2-Storey	3-Storey
Wood frame & siding or stucco	250 mm (9-7/8")	350 mm (13-3/4")	450 mm (17-3/4")
Wood frame & masonry veneer	315 mm (12-1/2")	480 mm (19")	645 mm (25-5/8")
Masonry construction	380 mm (15")	610 mm (24")	840 mm (33-1/8")
Insulating concrete forms	400 mm (15-3/4")	650 mm (25-1/2")	900 mm (35-3/8")

Note: footings support above ground walls of masonry, flat insulating form foundation walls or light wood frame construction, and floors and roofs of light wood frame construction.

(9.15.3.3.)
(9.15.3.4.)
(9.15.3.5.)

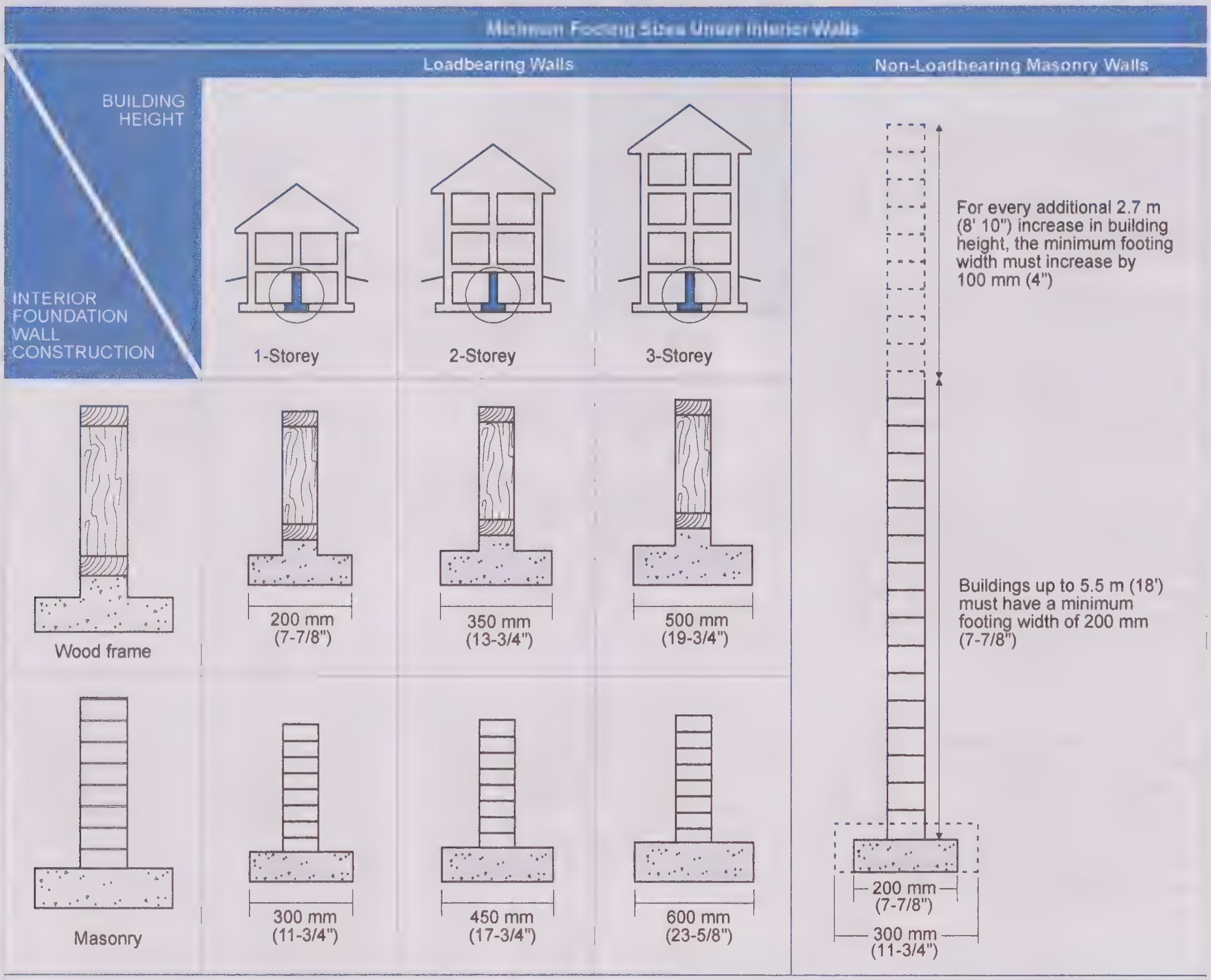
Figure 2.8
Footings Sizes Under Exterior Walls

T is greater than or equal to P but is not less than 100 mm (4")



(9.15.3.2.)
(9.15.3.8.)

Figure 2.9
Requirements Common to all Footings



Note: footings support above ground walls of masonry, flat insulating form foundation walls or light wood frame construction, and floors and roofs of light wood frame construction.

Figure 2.10
Footings Under Interior Walls

(9.15.3.3.)
(9.15.3.4.)
(9.15.3.6.)

Better Building Note

Design Footings in Conjunction with Foundation Walls

The minimum required footing sizes in some cases can be calculated or can be less than the minimum required width of the foundation wall.

In practice, the foundation wall thickness would establish the footing width.

Having determined the footing size, it is necessary to determine the required thickness as shown in Figure 2.9. The footing thickness, T, must equal the footing projection, P, and be not less than 100 mm (4"). Note that special soil conditions or footing cases may require different footing sizes than those contained in the figures.

Ensure that all footings are only constructed on undisturbed soil, rock or compacted granular fill and that the required concrete type and strength are supplied. Figure 2.11 illustrates Article 9.4.4.2. which deals with design concerns when more than one soil type is encountered beneath a footing. While curing, concrete must be protected from rain and freezing conditions to ensure it achieves adequate strength and durability. Avoid removing formwork until the concrete has completely set. Figure 2.12 shows how footing sizes must be adjusted where the supported joist spans exceed 4.9 m (16' 1").

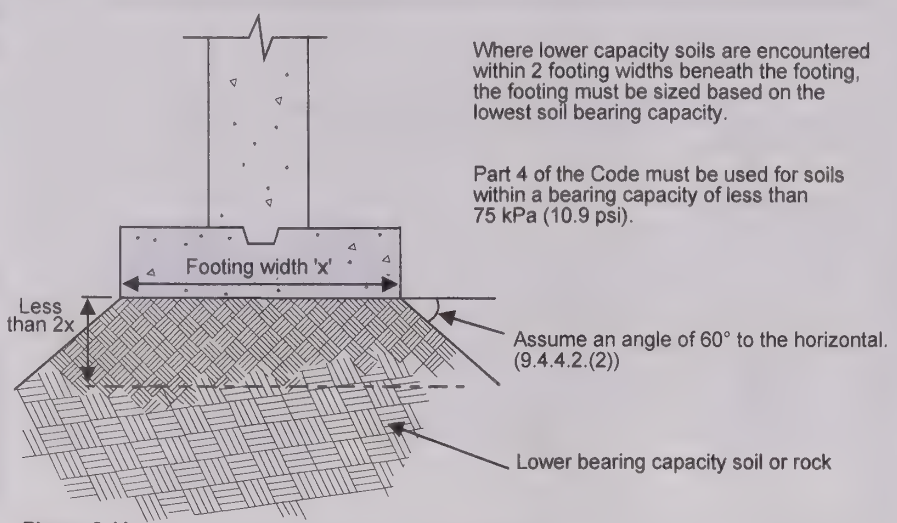
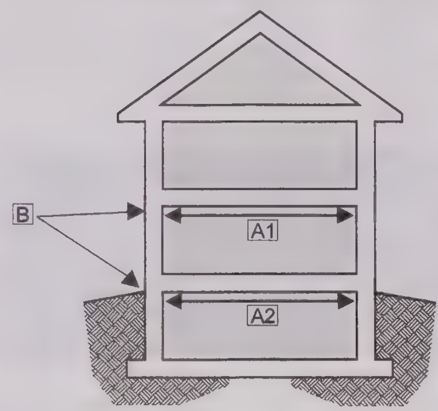


Figure 2.11
Requirements For Footings Above Low Capacity Soils (9.4.4.2.)



$$\text{Minimum Footing Width} = \left[\frac{\boxed{A}}{\boxed{B} \times 4.9}\right] \times \boxed{C}$$

A = sum of joist spans of all storeys

B = number of storeys

C = minimum footing width from Code (See Figure 2.8)

4.9 m = maximum floor span generally permitted

If floor spans A1 and A2 are 6.8 m in this 2 storey house, with masonry veneer, what is the minimum footing width?

SOLUTION Minimum footing width $= \dfrac{\text{(sum of joist spans of all storeys)}}{\text{(number of storeys x 4.9 m)}} \times \boxed{C}$

$= \dfrac{(6.8\text{ m} + 6.8\text{ m})}{(2 \times 4.9\text{ m})} \times \boxed{C}$

$= \dfrac{13.6\text{ m}}{9.8\text{ m}} \times \boxed{C}$

$= 1.39 \times \boxed{C}$

= 1.39 X 480 mm

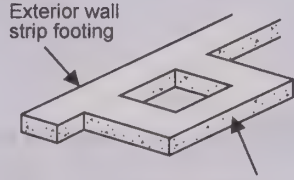
= 667 mm (26-1/2")

Figure 2.12
Footing Sizes for Floor Spans Greater than 4.9 m (16' 1") 9.15.3.4. 9.15.3.5.

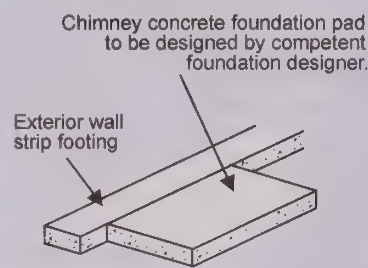
Fireplace and Chimney Footings

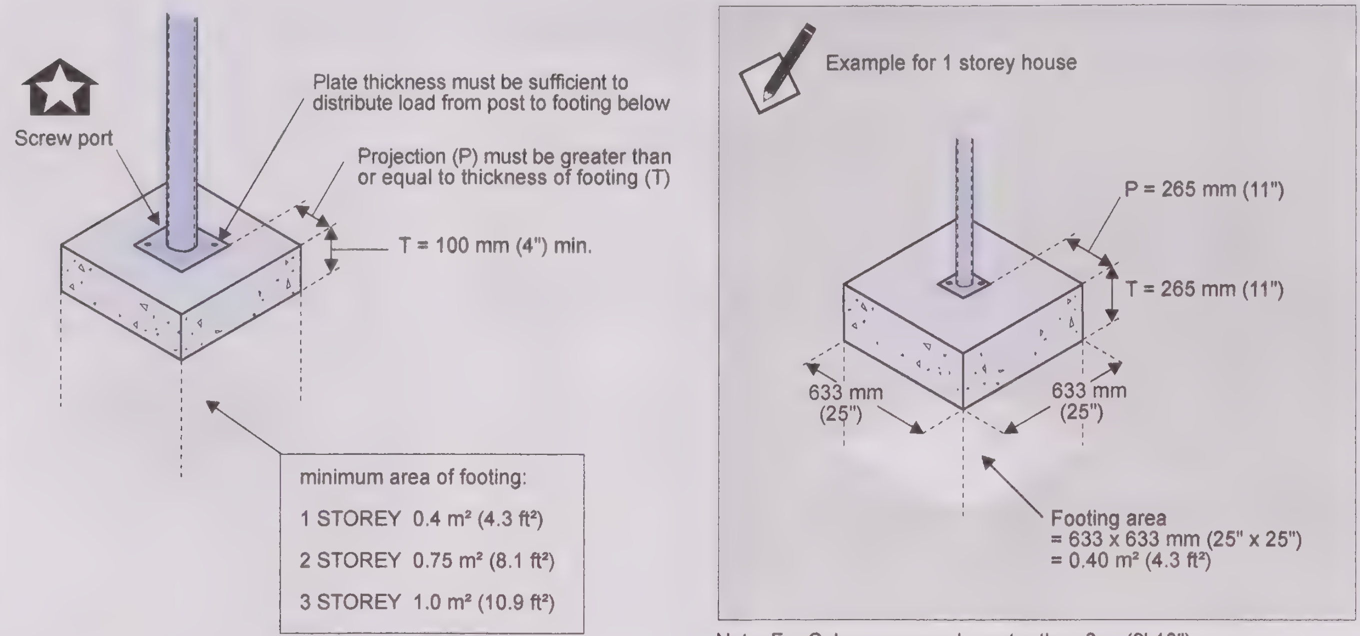
Chimney and fireplace foundations can be designed using provisions of the Building Code. Strip footings can be designed in a way similar to the approach taken for interior foundation walls supporting masonry. The number of storeys of masonry supported must correspond to the storey height of the chimney or fireplace.

Pad foundations are beyond the scope of the Building Code and must be designed by an individual competent in the design of foundations.



Chimney strip footing attached to an exterior wall tobe designed as an exterior footing supporting masonry construction; where chimney footing is not attached to exterior wall and is entirely inside of dwelling, design as interior footing.





Note: For Columns spaced greater than 3 m (9' 10") o.c. see Figure 2.14

Figure 2.13
Minimum Column Footing Sizes for Columns Spaced 3 m (9' 10") o.c.

(9.15.3.4.)
(9.15.3.8.)

Columns

The sizes of column footings are based on the assumptions and limitations discussed previously. The maximum spacing between columns is assumed to be 3.0 m (9' 10"). Where this is exceeded, the size of the column footing must be increased in proportion to the increase in column spacing. Figure 2.13 illustrates how the minimum footing sizes are determined while Figure 2.14 illustrates the proportional relationship between footing sizes and column spacing.

A & B = span of joists from foundation to beam

C = spacing between columns (max. 3.0 m (9' 10") for footing sizes shown in figure 2.14 (column spacing may be increased to 4.9 m (16' 1") maximum, check beam size and see example))

A/2 + B/2 = supported joist length

(A/2 + B/2) X C X 2.4 kPa (50 psf) = maximum allowed load on one column

Footing areas for columns spaced greater than 3 m o.c. must be adjusted in proportion to the distance between columns (9.15.3.7.)

Example:
If spacing between columns is increased by 10%, the load on the column will be 10% greater and the area of footing in Figure 2.14, will therefore have increased by 10%

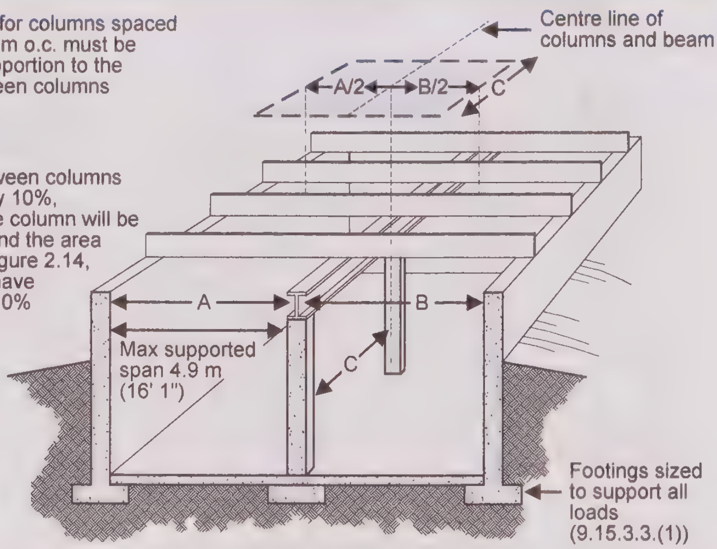


Figure 2.14
Adjusting Footing Sizes

(9.15.3.7.)

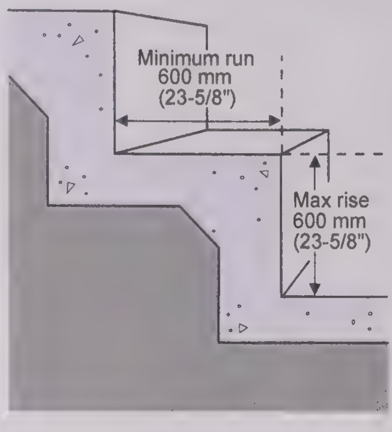


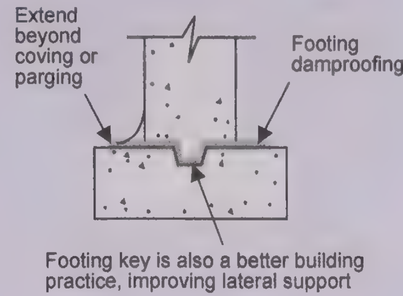
Figure 2.15
Step Footings (9.15.3.9.)

Step Footings

Step footings, where required, are intended to transfer loads to the soil without causing a lateral load at the footing level. The vertical rise and horizontal run of stepped footings are limited to the values illustrated in Figure 2.15.

Better Building Note

The control of water wicking from the soil into the footing (capillary moisture migration) and up through the foundation walls is not required by the Building Code. The spalling of above grade concrete walls and parging may be reduced by sealing the footing with dampproofing material prior to the construction of foundation walls. The figure beside depicts one means of implementing this better building practice.



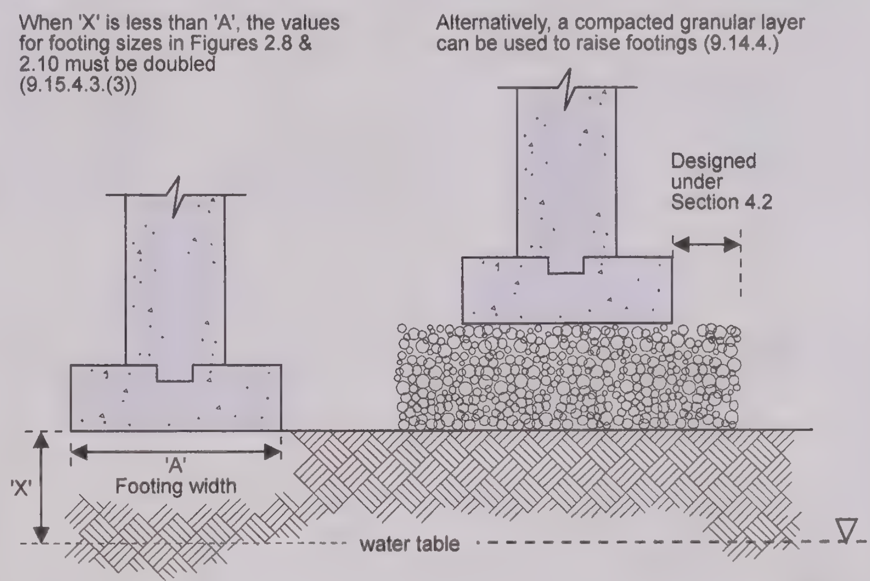


Figure 2.16
High Water Footings (9.4.4.1.) (9.4.4.3.) (9.15.3.2.) (9.15.3.4.)

Special Footing Cases

There are a number of special footing cases which may arise during the construction of foundations. Many of these may require competent foundation design. Common cases are those such as a high water table and the use of zero lot line footings.

Zero Lot Line Footings

Zero lot line footings can be used in those situations where space is constrained. These footings will normally require competent design.

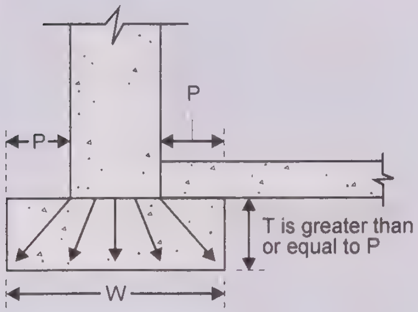
High Water Table

A high water table weakens the load-bearing capacity of the soil. Where high water tables are present the footing width must be doubled as required by the Code (See Figure 2.16). Alternatively, a compacted granular layer may be used to raise the bottom of the footing sufficiently to avoid this requirement. See the information on Foundation and Surface Drainage included later in this chapter for further information.

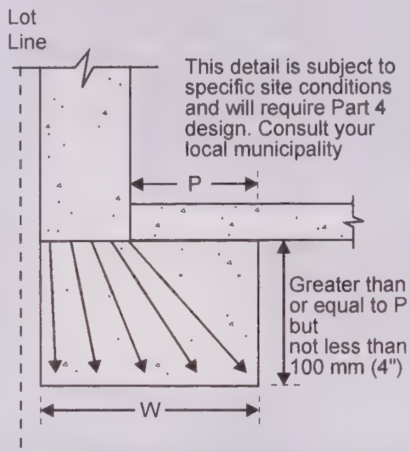
Lot Line Footings

Where footings are located adjacent to a lot line, it is necessary to increase the thickness of the footing to result in the same load distribution as a common footing (see illustration). It is important to consider any necessary adjustments as this requirement may impact finished building grade and proper drainage.

Conventional Footing



Lot Line Footing

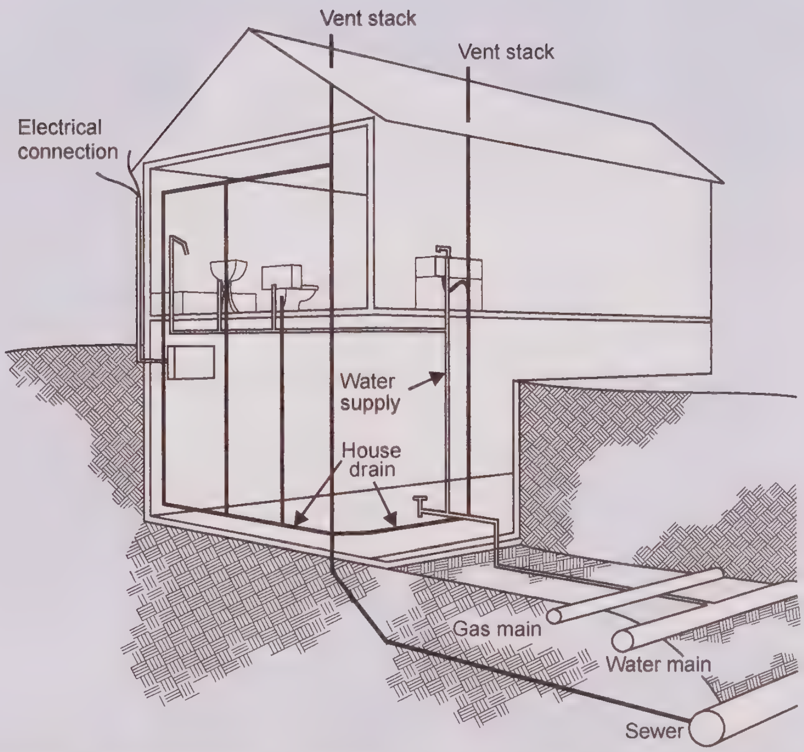


Looking Ahead

The need to consider service connections and rough-in arises prior to, during and after the construction of footings. Referring to the attached figure, it should be recognized that provision for the following service connections and rough-in may be required:

- sewers (sanitary and storm)
- potable water
- electrical service
- natural gas
- telephone and cable TV

Where trenches are used beneath footings, the soil shall be compacted by tamping up to the level of the footing base.



FOUNDATION WALLS

BUILDING CODE REFERENCES

DIVISION B

9.4.1.1.	General
9.4.4.6.	Walls Supporting Drained Earth
9.15.2.2.	Unit Masonry Construction
9.15.2.4.	Wood Frame Foundations
9.15.4.1	Permanent Form Material
9.15.4.2.	Foundation Wall Thickness and Required Lateral Support
9.15.4.3	Foundation Walls Considered to be Laterally Supported at the Top
9.15.4.4.	Foundation Walls Considered to be Laterally Supported at the Bottom
9.15.4.5.	Reinforcement for Flat Insulating Concrete Form Foundation Walls
9.15.4.6.	Extension above Ground Level
9.15.4.7.	Reduction in Thickness
9.15.4.8.	Corbelling
9.15.4.9.	Crack Control Joints
9.15.4.10.	Interior Masonry Walls
9.20.12.2.	Corbelling for Cavity Walls
9.20.17.3.	Openings in Non-Loadbearing Flat Insulating Concrete Form Walls
9.20.17.4.	Openings in Loadbearing Flat Insulating Concrete Form Walls
9.20.17.5.	Framing Supported on Flat Insulating Concrete Form Walls

Foundation walls are intended to adequately support all loads transferred, including those from the building structure they support and any lateral soil and water pressures acting against them. In cases where a high water table exerts pressure on foundation walls, competent design according to Part 4 may be required.

All of the requirements for concrete foundation walls are based on concrete which has properly cured and attained its full strength. Ensure that all concrete has adequately cured before applying any loads or backfilling.

Solid Concrete and Masonry Foundation Walls

The design and construction of solid concrete and masonry foundation walls is presented in this Subsection. The use of approved materials and methods is essential to satisfy the requirements of the Code.

Concrete must conform to Subsection 9.3.1. of the Code. Table 9.3.1.7. in the Code depicts site-batched concrete mixes by volume required for various compressive strengths. In addition to concrete strength, its proper placement and vibration is equally important. Concrete must be placed and vibrated to avoid the segregation of aggregates and honeycombing.

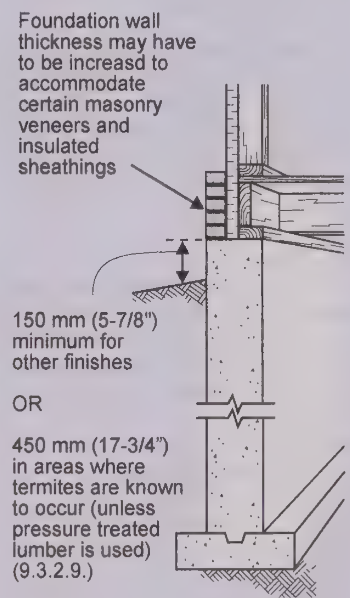
Admixtures such as plasticizers increase the slump of concrete and make placement easier without decreasing the concrete strength which can result from excessive watering. Removing forms before the concrete has fully set may result in cracking and loss of strength. Inadequate curing of concrete will also often result in lower strength and increased shrinkage cracking. Cold weather protection of concrete is necessary to prevent freezing of the mix which can significantly reduce strength and durability.

Acceptable masonry walls are the result of using appropriate materials and proper workmanship. Choose the appropriate grade of masonry units and mortar.

Looking Ahead

Depending on the type of construction selected for exterior wood-frame walls and the type of exterior finish or veneer, it may be necessary to construct foundation walls thicker than the minimum requirement.

Also note that the height of the foundation wall above finished grade must be at least 200 mm (7-7/8") when an exterior wood finish is used and 150 mm (5-7/8") for other finishes.



See Chapter 13 Insulation and See Chapter 15 Exterior Finishes

Material: Concrete

Concrete is a mixture of cement, water, aggregate and admixtures. The paste, comprised of Portland cement and water, binds the aggregates (sand and gravel or crushed stone) into a rocklike mass as the paste hardens because of the chemical reaction between the cement and water. Admixtures can entrain air, reduce the amount of water required, speed up or slow down the setting time and strength gain, or make the concrete very flowable.

Aggregates

Since aggregates make up about 60% to 75% of the total volume of concrete, their selection is important. Aggregates should consist of particles with adequate strength and resistance to exposure conditions and should not contain materials that will cause deterioration of the concrete. A continuous gradation of particle sizes is desirable to produce the best quality concrete.

The quality of the concrete depends to a great extent upon the quality of the paste. In a properly proportioned concrete mix, each particle of aggregate is completely coated with paste and the spaces between aggregate particles are filled with paste.

Admixtures

The freshly mixed (plastic state) and hardened properties of concrete may be changed by adding admixtures to the concrete, usually in liquid form, during batching. Admixtures are commonly used to
(1) adjust setting time or hardening,
(2) reduce water demand,
(3) increase workability,
(4) intentionally entrain air, and
(5) adjust other concrete properties.

Water-Cement Ratio

For any particular set of materials and conditions of curing, the quality of hardened concrete is determined by the amount of water used in relation to the amount of cement. This is called the water cement ratio. A number of options are available for increased flow or better consolidation. In no case should water be added for workability. The increased shrinkage, bleeding and subsidence as well as segregation from paste are major problems that can result from watering concrete, in addition to reduced strength and water tightness which inevitably occur.

Following are some advantages of reducing water content:

- increased compressive strength;
- less volume change from wetting and drying;
- reduced shrinkage cracking tendencies;
- lower permeability, thus increased watertightness and lower absorption;
- increased resistance to weathering; and
- better bond between successive layers and between concrete and reinforcement.

The standard used for concrete materials is:
CAN/CSA-A23.1 "Concrete Materials and Methods of Concrete Construction."

Definition of Laterally Supported or Unsupported Walls

Foundation walls are either laterally supported or unsupported. Exterior foundation walls are considered laterally supported under the following conditions: (1) if they support solid masonry construction; or (2) if the floor system is anchored to the foundation wall; or (3) if joists are embedded in the top of the foundation wall. These conditions are illustrated in Figure 2.17. Exterior foundation walls which are laterally supported are better able to resist lateral loads.

Exterior foundation walls are considered laterally unsupported if a sufficient portion of the wall is missing, as in the case of window or door openings. More specifically, when foundation walls contain openings greater than 1.2 m (3' 11") wide or containing openings whose total length exceed 25% of the total wall length, then the portion of the wall beneath such openings is considered laterally unsupported. In addition, when the length of solid wall between window openings is less than the average width of the window openings it separates, the window openings and separating wall are considered as a single opening. In some cases unsupported foundation walls hold up more backfill (measured from finished ground to basement floor) than Part 9 permits. In these situations, the foundation and the footing below the unsupported wall must be designed according to Part 4 of the Code. These conditions are illustrated in Figure 2.18.

Required Thickness

The required thickness for solid concrete and masonry foundation walls is illustrated in Figure 2.19. The height of the backfill on the wall establishes the lateral earth pressure that the wall must resist. The capacity to support backfill pressures also depends on whether the foundation wall is made from unreinforced concrete block, reinforced concrete block, solid concrete, or reinforced flat insulating concrete form foundation walls. Where solid concrete is used, its strength also determines acceptable backfill height.

Foundation walls are considered to be laterally supported at the top if:

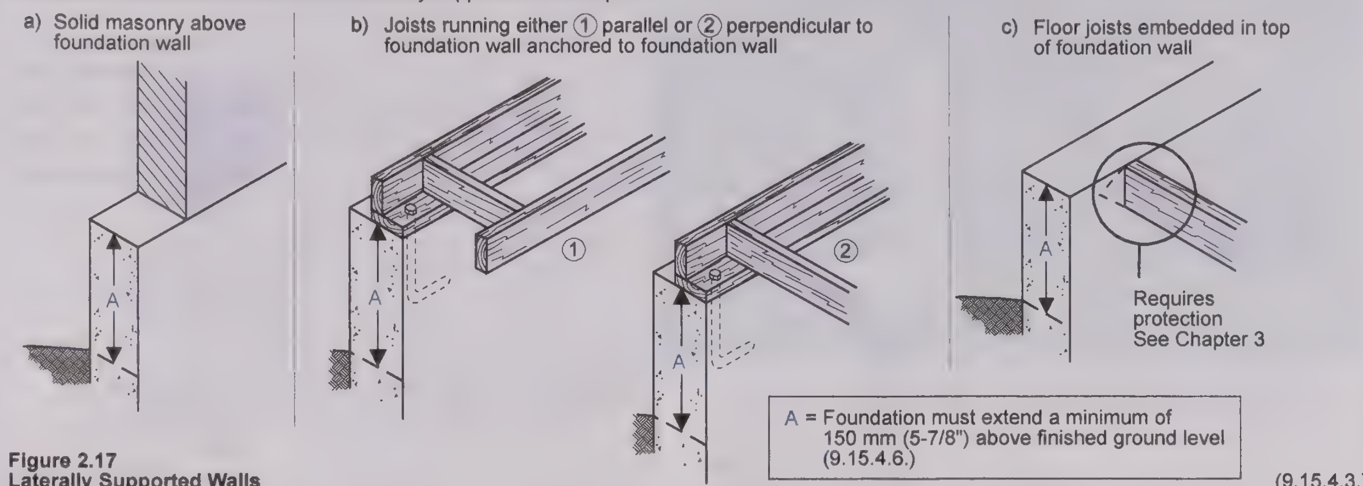
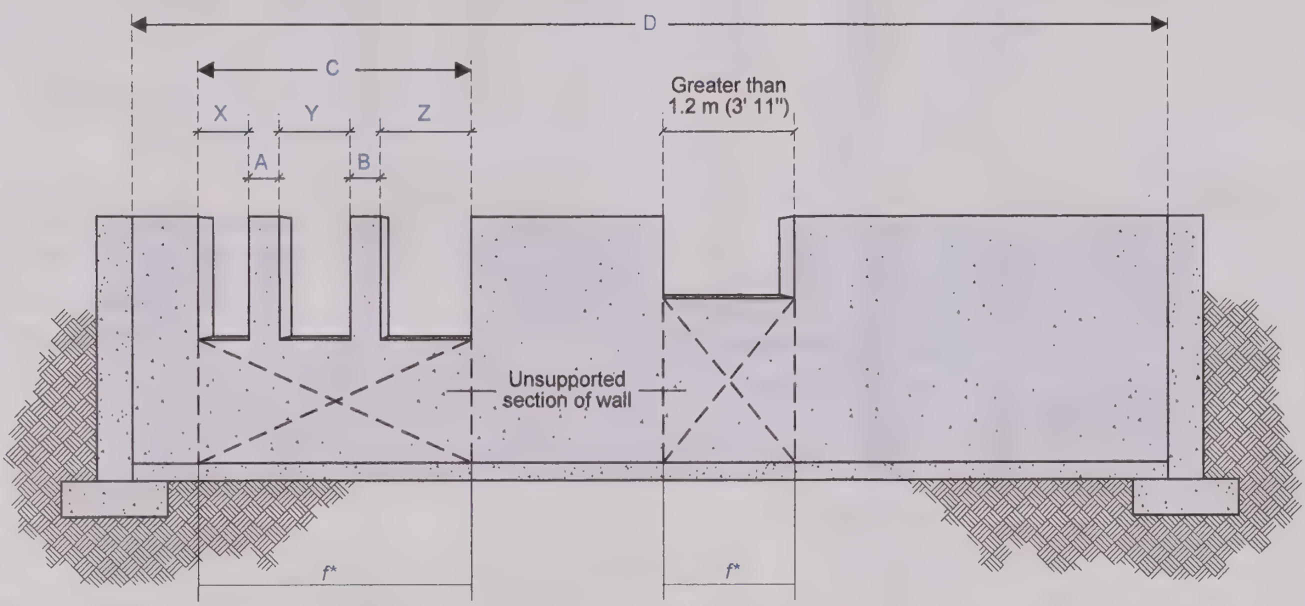


Figure 2.17
Laterally Supported Walls

(9.15.4.3.)



When the length of solid wall between openings is less than the average length of the windows, the combined length of such openings shall be considered as a single opening for the purpose of Sentence (3) above. (9.15.4.3.(4))

For example:

If A is less than X+Ydivided by 2, then the area beneath the opening is considered to be equal to: X+A+Y
If B is less than Y+Z divided by 2, then the area beneath the opening is considered to be equal to: X+A+Y+B+Z
If C is more than 25% of D or 1.2 m (3' 11"), then area beneath the opening C is unsupported

When a foundation wall contains an opening more than 1.2 m (3' 11") in length or contains openings in more than 25% of its length, that portion of the wall beneath such openings shall be considered laterally unsupported, unless the wall around the opening is reinforced to withstand the earth pressure. Such reinforcing must be designed to meet Part 4. (9.15.4.3.(3))

f* : If the finished ground is more than 1.5 m (4' 11") above the basement floor (ground cover or crawl space areas) where the foundation wall is laterally unsupported and the footings it rests on must be designed according to Part 4 to resist overturning and sliding.

Figure 2.18
Laterally Unsupported Walls

(9.15.4.3.)

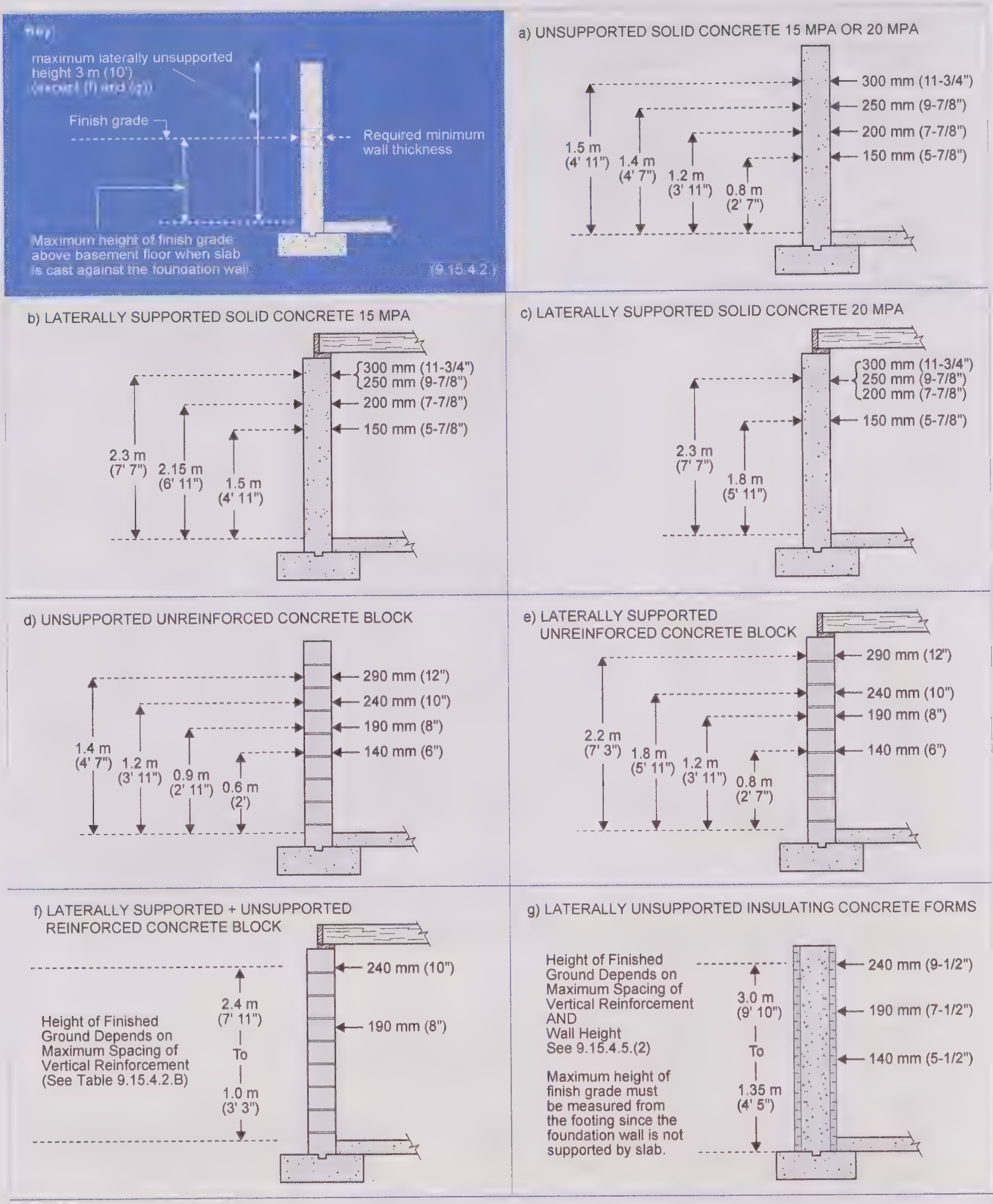
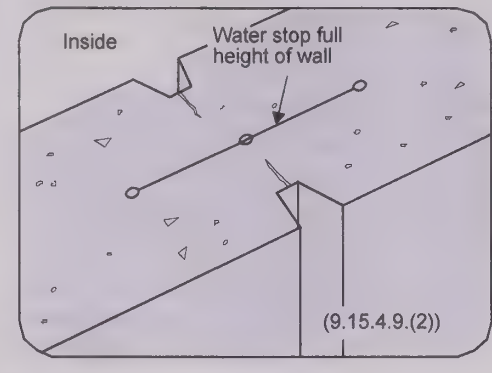


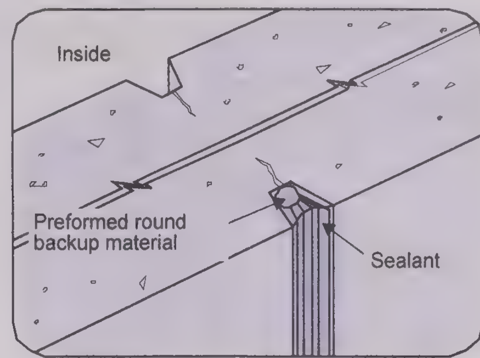
Figure 2.19
Determining Foundation Wall Thickness and Maximum Height of Finished Ground

(9.15.4.2.)
(9.15.4.5.)

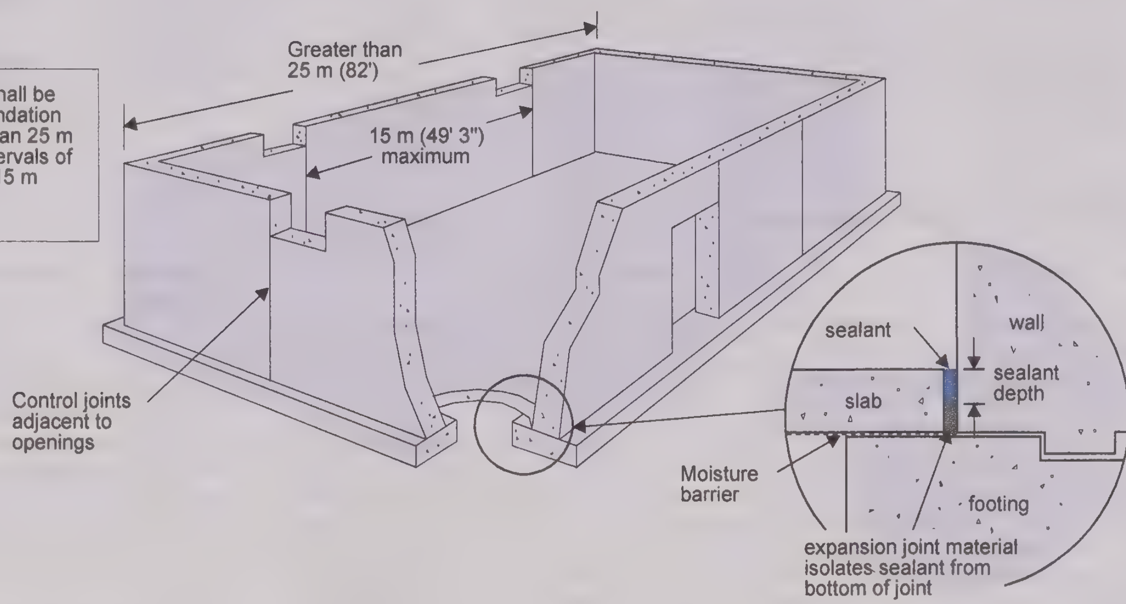
Water Stop Control Joint



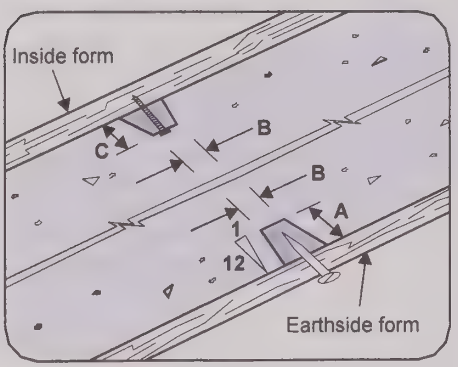
Sealed Control Joint



Control joints shall be provided in foundation walls greater than 25 m (82') long at intervals of not more than 15 m (49' 3") (9.15.4.9.(1))



Forming Control Joints



Vertical Control Joints should have a total depth of 1/4 the wall thickness, and should be made in the same location inside and out (**A+C**) OR on just the outside face (**A**).

Wall Thickness

	150 mm (5-7/8")	200 mm (7-7/8")	250 mm (9-3/4")
A Only	38 mm (1-1/2")	50 mm (2")	63 mm (2-1/2")
B	13 mm (1/2")	13 mm (1/2")	13 mm (1/2")
A+C	19 mm (3/4")	25 mm (1")	31 mm (1-1/4")

Figure 2.20
Crack Control Joints

(9.15.4.9.)

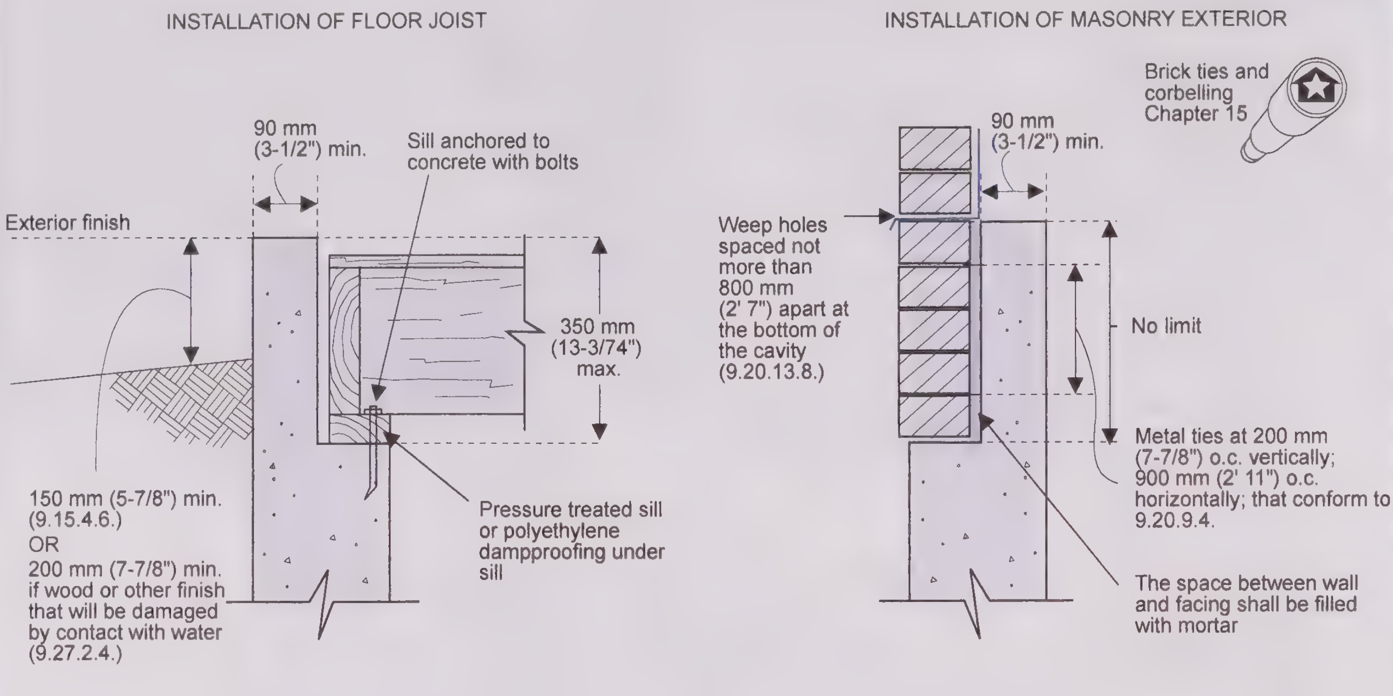


Figure 2.21
Reduction in Thickness of Foundation Walls (9.15.4.7.)

Crack Control Joints

Concrete is susceptible to shrinkage. Cracks in foundation walls that may result could create the potential for water leakage.

Crack control joints introduce points of weakness in the wall where shrinkage cracking may be predicted to occur. By suitably sealing these control joints with a water impermeable material when the joints are made, cracks which would otherwise randomly occur are induced to form at a location which is already sealed against water leakage. Figure 2.20 on the previous page illustrates the requirements for, and some means of, providing crack control joints in foundations.

Special Cases

There are a number of special foundation wall cases which may arise during the construction of foundations.

Part 9 of the Code describes approaches to the design of foundations for limited prescribed cases. Special cases not explicitly provided for within Part 9 of the Code are governed by Part 4. Part 4 design procedures must be executed by an individual competent and knowledgeable in the design of foundations.

Reduction in Foundation Wall Thickness

Foundation wall thickness may be reduced in order to permit the installation of floor joists or the installation of an exterior masonry veneer. In both cases, the reduced wall thickness must not be less than 90 mm (3-1/2"). Where the wall thickness is reduced to accommodate the installation of exterior masonry, the facing material must be properly tied to the reduced section of the foundation wall, and the space between the facing and the wall filled with mortar to increase strength. Figure 2.21 illustrates the requirements governing reductions in wall thickness. Where the foundation wall thickness is reduced to accommodate floor joists, the height of the reduced wall is limited to 350 mm (13-3/4"). There is no height limit for wall thicknesses reduced to accommodate masonry veneer.

Preserved Wood Foundation Walls

The design of preserved wood foundations is governed by the standard CAN/CSA-S406, Construction of Preserved Wood Foundations or Part 4 of the Code. Figure 2.22 illustrates a typical preserved wood foundation installation. Note that in addition to providing adequate structural strength, it is important that preserved wood foundations are well protected from moisture, both exterior and interior.

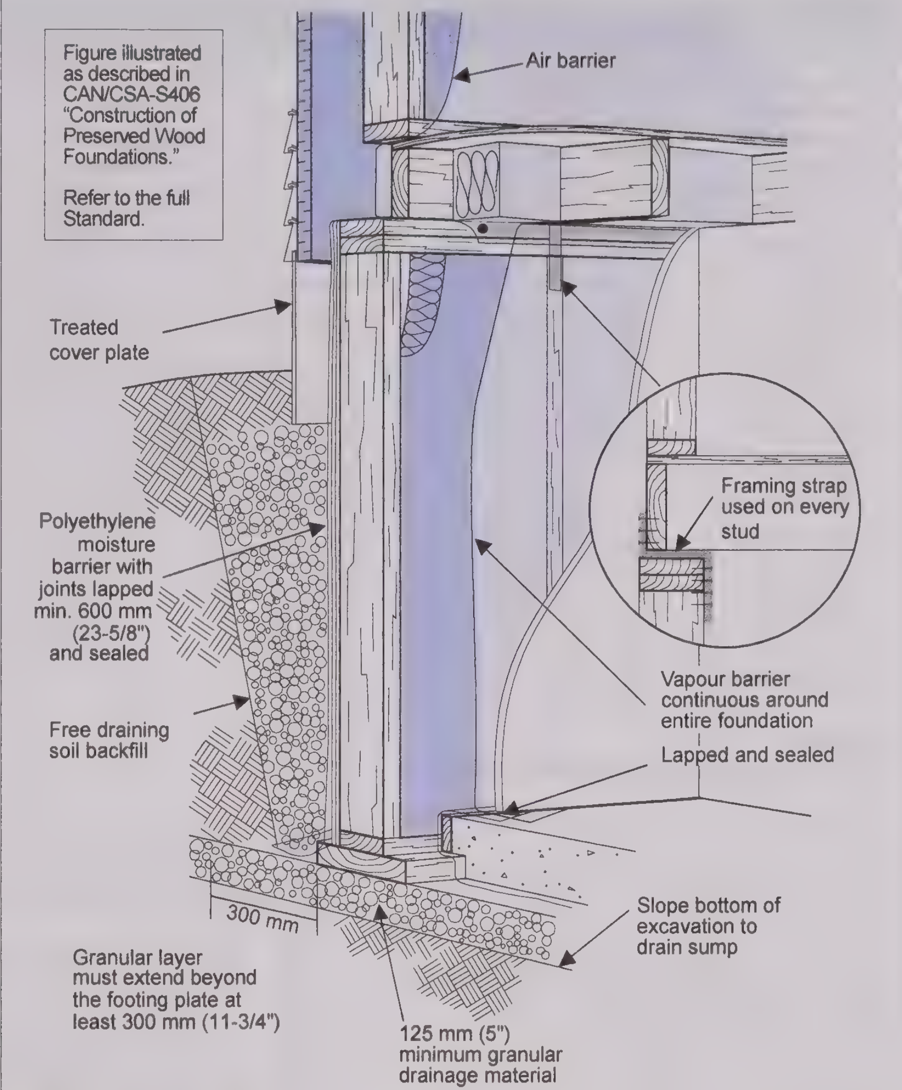


Figure 2.22
Preserved Wood Foundation (9.15.2.4.)

Vertical Reinforcement Spacing for Flat Insulating Concrete Form Foundation Walls

Maximum Thickness of Foundation Wall mm (in)	Maximum Height of Finished Ground Above Finished Basement Floor, m (ft-in)	Maximum Unsupported Basement Wall Height		
		2.44 m (8' 0")	2.75 m (9' 0")	3.00 m (9' 10")
		Minimum Vertical Reinforcement		
140 (5-1/2")	1.35 (4' 5")	10M at 400 mm (15-3/4") o.c.	10M at 400 mm (15-3/4") o.c.	10M at 400 mm (15-3/4") o.c.
140 (5-1/2")	1.60 (5' 3")	10M at 400 mm (15-3/4") o.c.	10M at 380 mm (15") o.c.	10M at 380 mm (15") o.c.
140 (5-1/2")	2.00 (6' 7")	10M at 380 mm (15") o.c.	10M at 380 mm (15") o.c.	10M at 380 mm (15") o.c.
140 (5-1/2")	2.20 (7' 3")	10M at 250 mm (10") o.c.	10M at 250 mm (10") o.c.	10M at 250 mm (10") o.c.
140 (5-1/2")	2.35 (7' 9")	n/a	10M at 250 mm (10") o.c.	10M at 250 mm (10") o.c.
140 (5-1/2")	2.60 (8' 6")	n/a	10M at 250 mm (10") o.c.	10M at 250 mm (10") o.c.
140 (5-1/2")	3.00 (9' 10")	n/a	n/a	15M at 250 mm (10") o.c.
190 (7-1/2")	2.20 (7' 3")	None Required	10M at 400 mm (15-3/4") o.c.	10M at 400 mm (15-3/4") o.c.
190 (7-1/2")	2.35 (7' 9")	n/a	10M at 300 mm (11-3/4") o.c.	10M at 300 mm (11-3/4") o.c.
190 (7-1/2")	2.60 (8' 6")	n/a	10M at 300 mm (11-3/4") o.c.	15M at 400 mm (15-3/4") o.c.
190 (7-1/2")	3.00 (9' 10")	n/a	n/a	15M at 400 mm (15-3/4") o.c.
240 (9-1/2")	2.20 (7' 3")	None Required	None Required	None Required
240 (9-1/2")	2.60 (8' 6")	n/a	15M at 400 mm (15-3/4") o.c.	15M at 400 mm (15-3/4") o.c
240 (9-1/2")	3.00 (9' 10")	n/a	n/a	15M at 400 mm (15-3/4") o.c.

Figure 2.23
Vertical Reinforcement Spacing Requirements (9.15.4.5.(2))

Insulating Concrete Form (ICF) Foundation Walls

Insulating concrete form (ICF) foundation walls offer the combination of structural, insulation, and moisture control functions in a single system.

ICFs are permanent forms made of foam plastic that enclose the foundation's concrete and insulate the basement of the dwelling unit at the same time. They are assembled into the shape of the building's foundation and are filled with reinforced concrete to create structural foundation walls. The Building Code requires the foam plastic used in ICFs be manufactured of Type 2, 3, or 4 polystyrene conforming to the performance requirements of CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering". Part 9 of the Code includes requirements for flat insulating concrete form foundation walls. Other types of ICF walls may be installed where permitted by Minister's Ruling or the BMEC (Building Materials Evaluation Commission) approval.

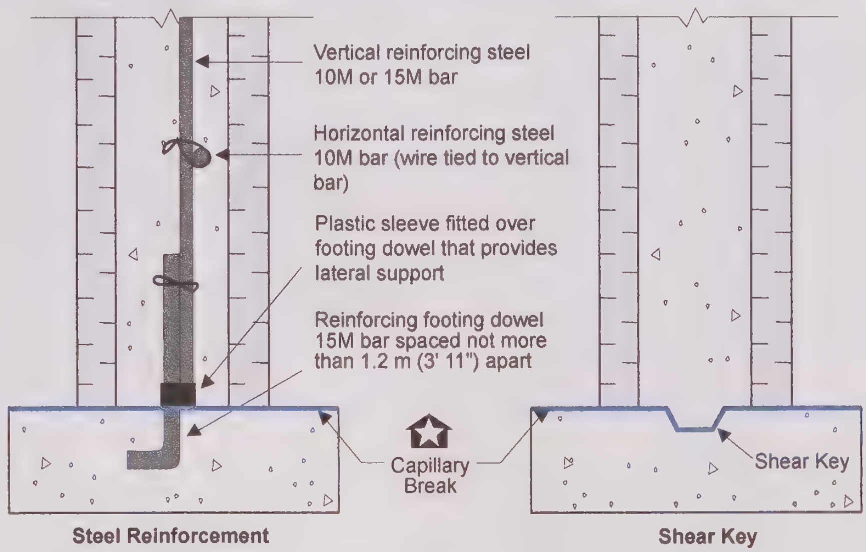


Figure 2.24
Lateral Support at the Bottom of ICF Foundation Walls (9.15.4.4.)

Like other foundation walls, ICF foundation walls must not be greater than 2.5 m (8' 2") in unsupported height unless they are designed under Part 4 of the Code. Their thickness is determined in the same way as other concrete foundation walls as shown in Figure 2.23. The thickness of the concrete foundation walls must never be less than the greater of 140 mm (5-1/2") or, where the foundation supports concrete walls above, the thickness of the above grade concrete walls.

Lateral Support

ICF walls need to be laterally supported at the top and at the bottom. Lateral support for the foundation wall at the bottom is needed where the foundation supports backfill more than 1.2 m (3' 11") in height. Typically lateral support at the bottom of the wall can be provided by a shear key at the footing or by 15M bars dowelled into the footing and spaced not more than 1.2 m (3' 11") apart (See Figure 2.24). Alternatively, the footing can be designed according to Part 4 to resist sliding and overturning.

Reinforcement

Horizontal reinforcement consisting of at least 10M bars must be installed and spaced not more than 600 mm (23-5/8") apart and not more than 300 mm (11-3/4") from the top of the wall. Vertical reinforcement must be installed within the inside half of the concrete wall section and must have a concrete cover of at least 30 mm (1-1/4"). Where vertical reinforcement is interrupted by wall openings it must be installed not more than 600 mm (23-5/8") from each side of the opening. Reinforcing around openings in ICF walls is treated in the same manner as above grade ICF walls and is shown in Chapter 7 Wall Systems.

Cold joints in ICF foundation walls occur at the pour line and must be reinforced with at least one 15M reinforcing bar spaced not more than 600 mm (23-5/8") o.c. apart and embedded at least 300 mm (11-3/4") on both sides of the joint. Figure 2.25 summarizes the reinforcement requirements for ICF foundation walls. While the Building Code includes requirements for ICF walls, there are other proprietary ICF walls that can be used for greater heights than those meeting Building Code requirements.

Looking Ahead

See Chapter 7 for above grade ICF walls.

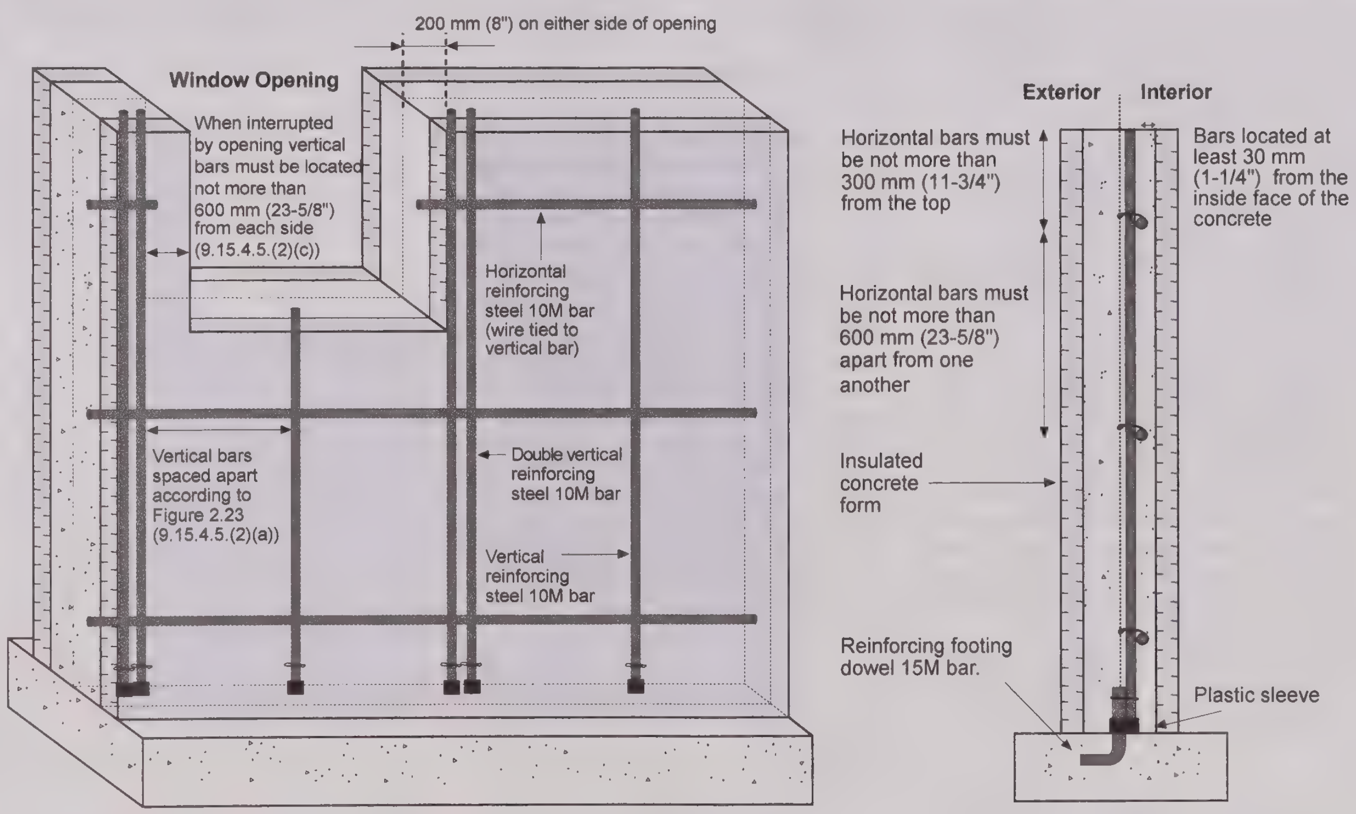


Figure 2.25
Reinforcement for Flat Insulating Concrete Form Foundation Walls

(9.15.4.4.)
(9.15.4.5.)

ADDITIONAL FOUNDATION STRUCTURAL ELEMENTS

BUILDING CODE REFERENCES

DIVISION B

9.4.1.1.	General
9.15.5.1.	Support of Floor Joists
9.15.5.2.	Support of Beams
9.15.5.3.	Pilasters
9.16.2.1.	Required Installation of Granular Fill
9.16.2.2	Support of Floors
9.17.	Columns
9.17.1.1.	Application
9.17.2.1.	Location
9.17.2.2	Lateral Support
9.17.3	Steel Columns
9.17.3.1	Size and Thickness
9.17.3.2.	End Bearing Plates
9.17.3.3.	Paint
9.17.3.4.	Design of Adjustable Steel Columns
9.17.4.	Wood Columns
9.17.4.1.	Column Sizes
9.17.4.2.	Materials
9.17.4.3.	Columns in Contact with Concrete
9.17.4.4.	Wood Column Termite Protection
9.17.5.	Unit Masonry Columns
9.17.5.1.	Materials
9.17.5.2.	Sizes
9.17.6.	Solid Concrete Columns
9.17.6.1.	Materials
9.17.6.2.	Sizes
9.20.	Masonry and Insulating Concrete Walls not in Contact With the Ground
9.20.6.	Thickness and Height
9.20.6.3.	Thickness of Interior Walls
9.20.8.4.	Support of Beams and Columns
9.23.6.2.	Anchorage of Columns and Posts

A number of additional structural elements are commonly required during the construction of foundations prior to the installation of a floor system. It is often difficult to add these elements if they have not been considered during the foundation design stage. Three common types of additional structural elements are presented in the Subsections which follow.

Columns

Columns are used to support horizontal structural elements such as beams by transferring the loads they carry to the column footings. The failure of columns may be catastrophic and for this reason it is important that they are correctly sized, and bear onto the centre of the column footing as required by Code Section 9.15. Columns with a height of more than 600 mm (23-5/8") measured from finished ground to underside of supported member must be supported at the top. The member supported by the column must be mechanically fastened to the column or directly supported to resist lateral movement.

The requirements for columns which follow are limited to columns supporting applications described in Code Article 9.17.1.1. Columns for any applications other than those described in Article 9.17.1.1. must be designed in accordance with Part 4 of the Building Code.

Steel

The requirements for steel pipe columns are depicted in Figure 2.26. For other types of steel columns, it is necessary to demonstrate that these have an equivalent loadbearing capacity. In addition to providing the minimum outside diameter and wall thickness for steel pipe columns, it is particularly important to ensure full bearing of the top plate when it supports wooden beams. Steel columns must be centered on their footings. Adjustable steel columns may be used when loads do not exceed 36 kN (8093 lb). The design of the adjustable steel column must conform to the requirements in the standard CAN/CGSB-7.2 "Adjustable Steel Columns". Other steel columns must be designed to Part 4, Article 9.4.1.1., and 9.17.3.4. of the Code.

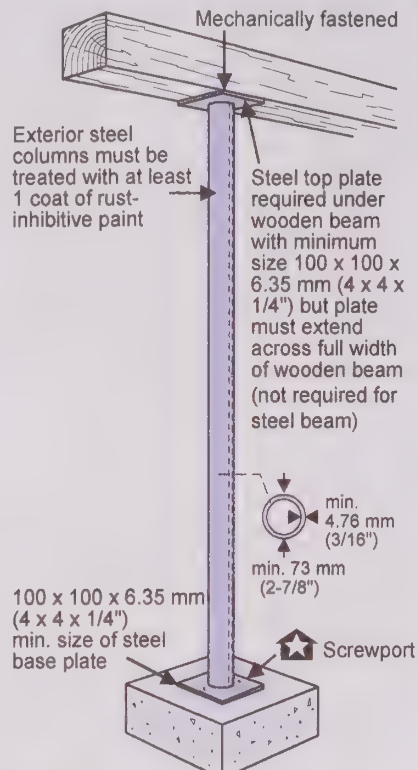


Figure 2.26
Steel Columns (9.17.3.)

Wood

Wood column requirements are illustrated in Figure 2.27. It is necessary to ensure that the width or diameter of a wood column is at least equal to the width of the structural member it supports (Figure 2.28). Glue laminated columns may be used but must conform to Section 4.3. of the Building Code.

All wood columns must be separated from the concrete in contact with the ground by 0.05 mm (2 mil) polyethylene or Type 2 roll roofing. Additional measures are required where termites are known to exist as shown in Figure 2.27.

Unit Masonry and Concrete

All unit masonry columns must be constructed using loadbearing units conforming to CSA A165.1, "Concrete Block Masonry Units." In the case of solid concrete columns, the minimum compressive strength required is 15 MPa (2200 psi). Requirements for unit masonry and solid concrete columns are depicted in Figures 2.29 and 2.30.

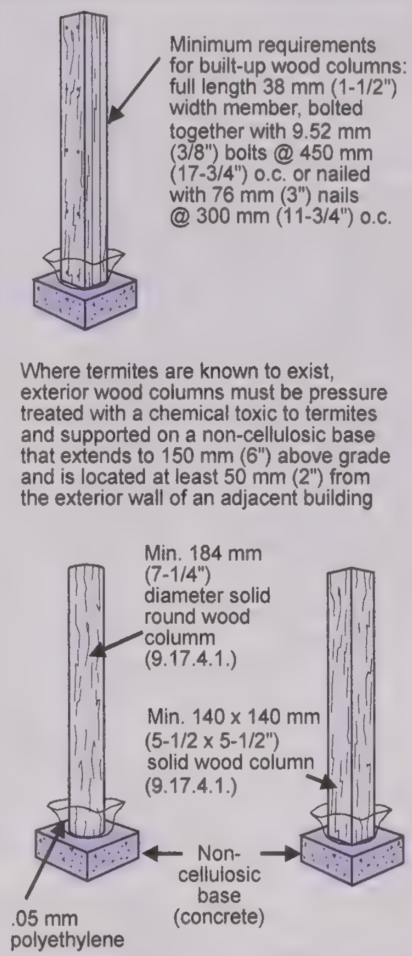


Figure 2.27
Wood Columns (9.17.4.)

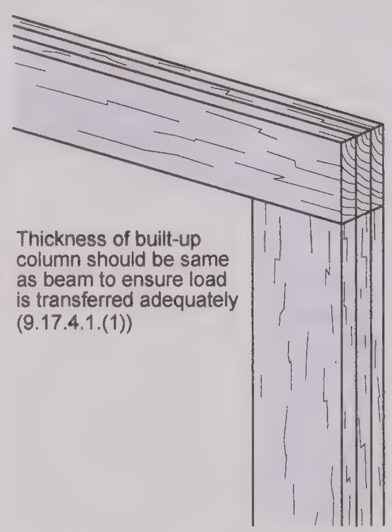


Figure 2.28
Width of Column to Structural Member

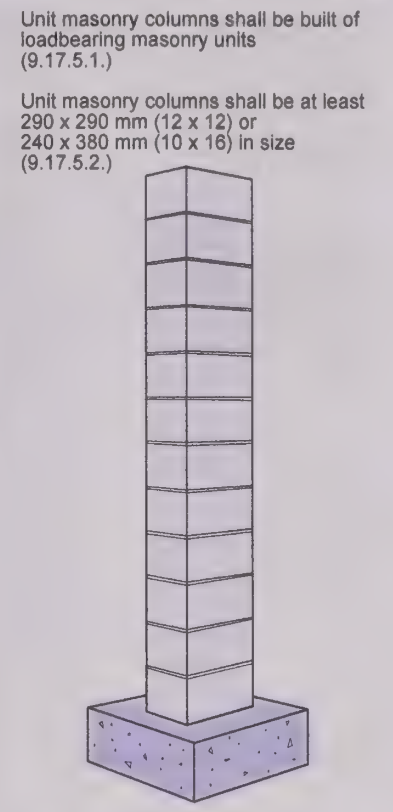


Figure 2.29
Unit Masonry Columns (9.17.5.)

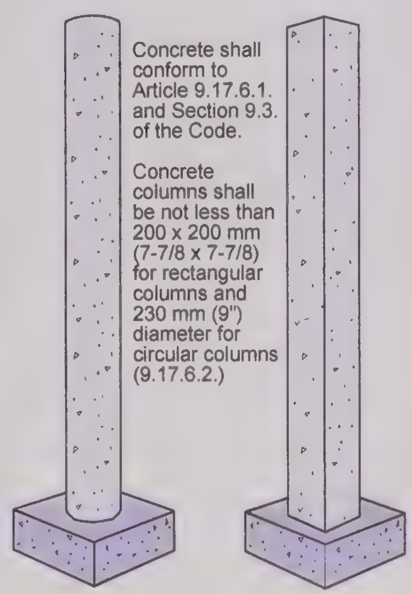


Figure 2.30
Concrete Columns (9.17.6.)

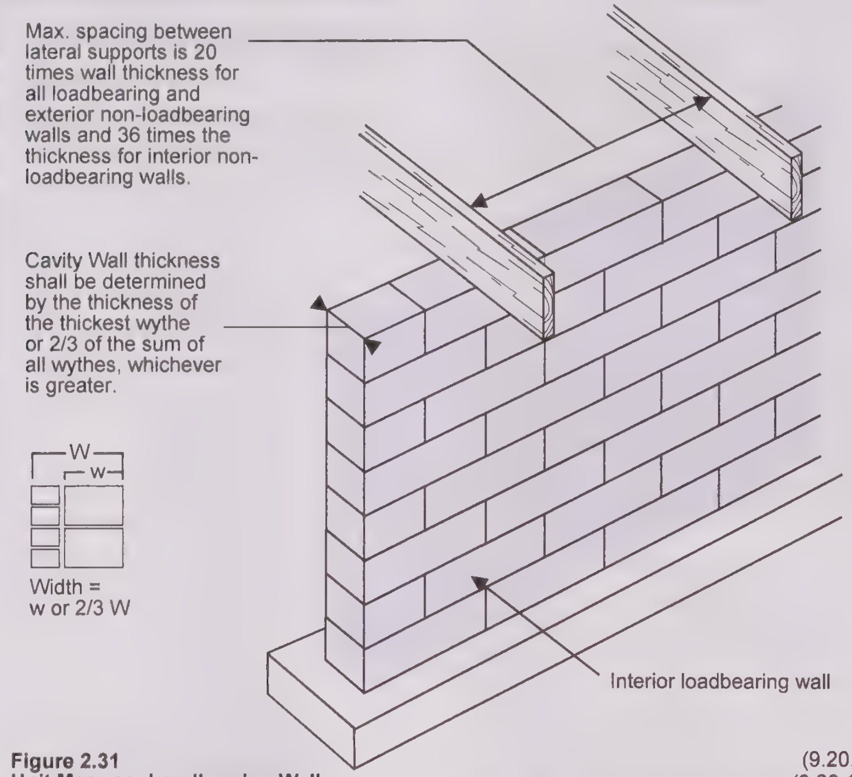


Figure 2.31
Unit Masonry Loadbearing Walls
(9.20.6.3.)
(9.20.10.1.)

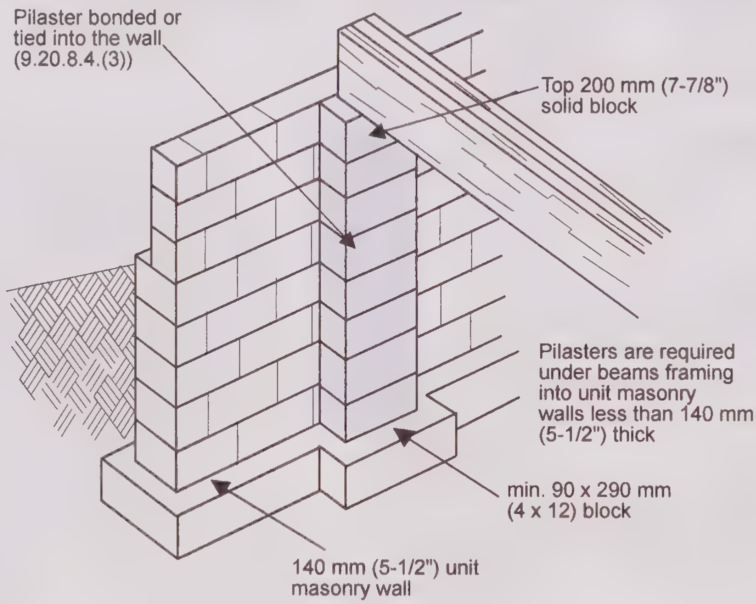


Figure 2.32
Pilaster Support
(9.15.5.3.)

Interior Bearing Walls

The minimum width for an interior masonry loadbearing wall should not be less than 1/20th of the height of the wall, however, the wall must be laterally supported at right angles by floor or roof construction, or by intersecting masonry walls or buttresses. The maximum spacing of such supports can be no greater than 20 times the loadbearing wall thickness. Figure 2.31 illustrates the essential requirements for masonry loadbearing walls. Chapter 7, Wall Systems provides information regarding wood-frame loadbearing walls and masonry non-loadbearing walls.

Support Requirements

It is important to consider support requirements prior to and during the construction of foundations. Proper support of members such as beams, joists and slabs ensures that loads are safely transferred. Figure 2.33 illustrates minimum requirements for supports in foundations.

Pilasters

Pilasters are required when masonry walls that are 140 mm (5-1/2") thick or less support beams. The pilasters must measure at least 90 x 290 mm (4 x 12) and must be bonded or tied to the masonry wall. The top 200 mm (7-7/8") of the pilaster must either consist of a solid unit or be filled with concrete in order to evenly distribute the load from the supported beam to the pilaster. These requirements are illustrated in Figure 2.32.

Beams

For the proper support of beams, the minimum length of end bearing must be not less than 90 mm (3-5/8"). A minimum bearing depth of 190 mm (7-1/2") of solid masonry or concrete must be provided beneath the beam. It is also necessary to ensure that beams are adequately protected from the effects of weather to maintain their long term structural integrity.

Joists

The minimum length of end bearing for floor, roof or ceiling joists is 38 mm (1-1/2"). This requirement is intended to prevent the crushing of the wood joists or the sill plate which supports them at their bearing points. In any case, all hollow masonry units supporting floor, roof or ceiling joists must be capped by a minimum of 50 mm (2") of solid unit masonry or concrete.

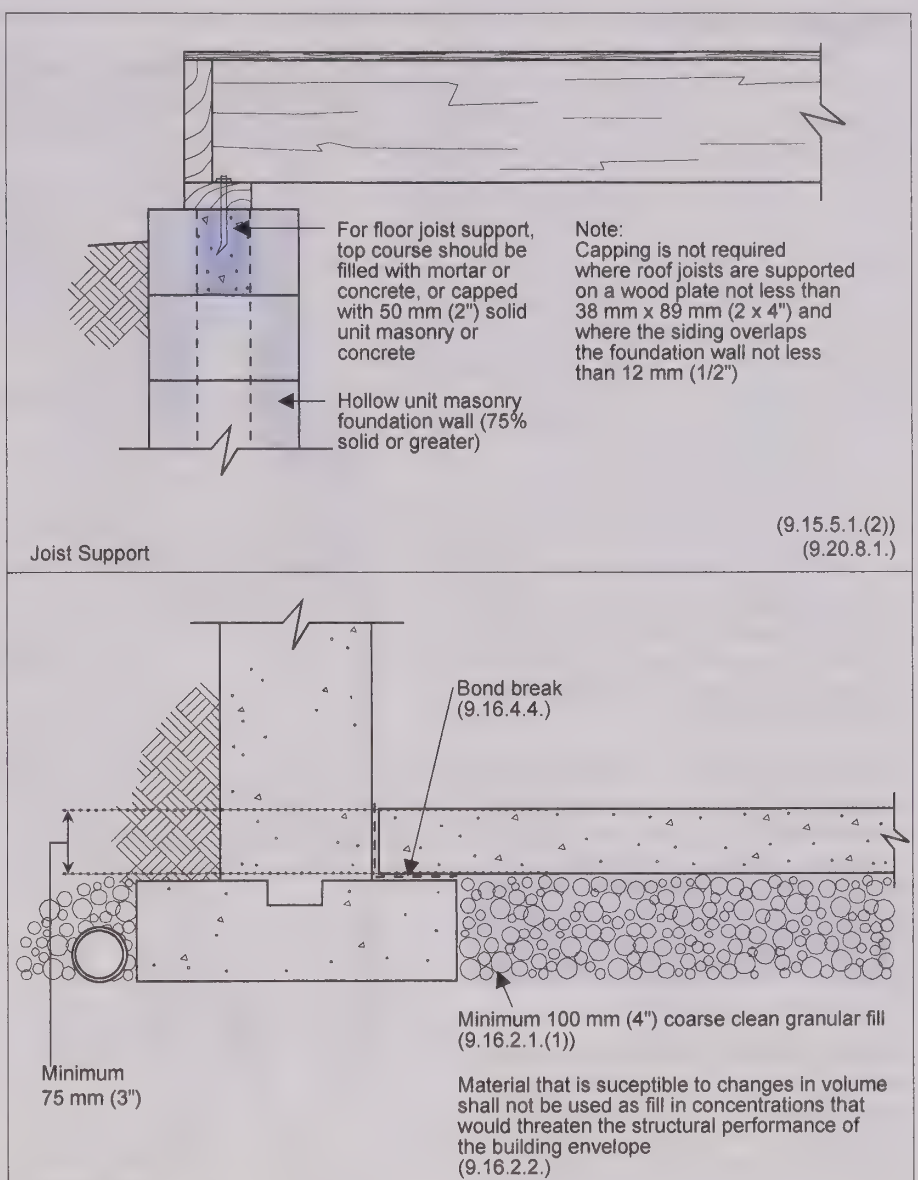


Figure 2.33
Support Requirements (9.16.2.)

Floors-on-ground

Floors-on-ground must be supported by a firm base in order to reduce the likelihood of settlement cracks. A minimum of 100 mm (4") of coarse, clean granular material is required under all slabs-on-ground except for garages or carports. Granular material need not be compacted, however any other fill beneath this granular material must be well compacted. Fill beneath garage slabs must also be compacted. Please see the section entitled Floors-On-Ground later in this Chapter for further requirements.

CRAWL SPACES

BUILDING CODE REFERENCES

DIVISION B

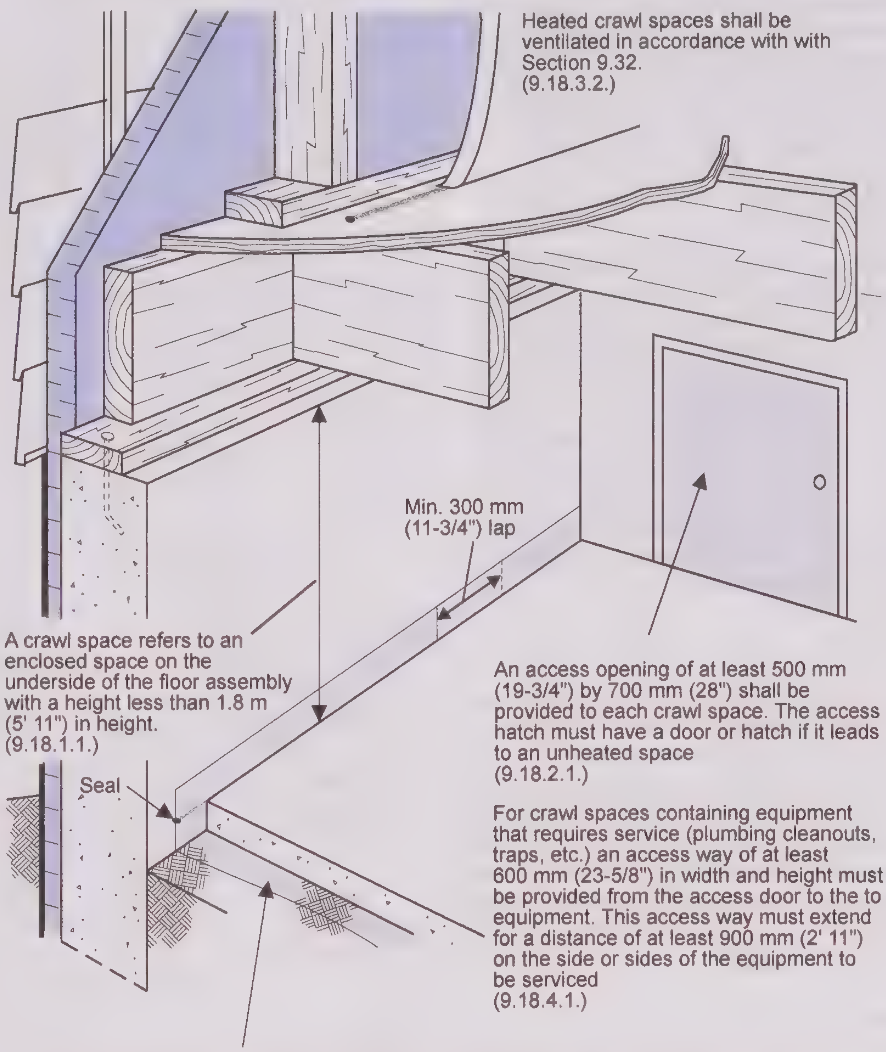
9.18.1.1.	Application
9.18.1.2.	Foundations
9.18.1.3.	Heated and Unheated Crawl Spaces
9.18.2.1.	Access Openings
9.18.3.1.	Ventilation of Unheated Crawl Spaces
9.18.3.2.	Ventilation of Heated Crawl Spaces
9.18.4.1.	Access Way to Services
9.18.5.1.	Drainage
9.18.6.1.	Ground Cover in Unheated Crawl Spaces
9.18.6.2.	Ground Cover in Heated Crawl Spaces
9.18.7.1.	Crawl Spaces as Warm Air Plenums

A crawl space is an enclosed space with a clearance of less than 1.8 m (5' 11") measured between the underside of a floor assembly and the ground cover directly below.

Crawl spaces may be either heated or unheated. All crawl spaces must be provided with an access opening and an access way to any services they may contain. Ground cover must also be provided according to Building Code Articles 9.18.6.1. and 9.18.6.2. to prevent moisture from getting into the crawl space from the soil.

Heated crawl spaces must be insulated and vented to the adjacent basement space, as illustrated in Figure 2.34. Where a crawl space is heated, a ground cover consisting of not less than 0.15 mm (6 mil) polyethylene sheet must be installed as part of the air barrier system, conforming to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet, for Use in Building Construction" with its joints sealed, lapped at least 300 mm (11-3/4"), and weighted down, or covered with a concrete skim coat not less than 50 mm (2") thick. The perimeter of the required ground cover shall be sealed to the foundation wall.

Crawl spaces are heated when used as a hot air plenum, containing unsealed or uninsulated heating ducts or pipes, or not separated from heated space in accordance with Section 9.25. of the Code. Heating of crawl spaces must conform to Section 9.33. and shall be ventilated in accordance with Section 9.32. (9.18.3.2.)



A ground cover conforming to CAN/CGSB-51.34-M "Vapour Barrier, Polyethylene Sheet, for Use in Building Construction" must be provided as part of the air barrier system. The sheet must be lapped 300 mm (11-3/4") min. at joints, and sealed and weighted down or covered with a concrete skim coat not less than 50 mm (2") thick. The perimeter of the ground cover must be sealed to the foundation wall. If the ground cover is a combustible material, it must be covered with a non-combustible material. (9.18.6.2., 9.18.7.1.(3))

NOTE: where soil gas protection is required see SB-9 for wall and slab sealing. Foam plastic that might be located inside must be protected

Figure 2.34
Heated Crawl Spaces (9.18.)

In the case of unheated crawl spaces, these must be well ventilated by natural or mechanical means in order to prevent moisture accumulation in the space and potential damage to the floor assembly. Figure 2.35 illustrates the essential requirements for unheated crawl spaces. Additional requirements may be found in Section 9.18. of the Code. Where a crawl space is unheated, a ground cover must be provided of at least:

- 50 mm (2") of asphalt paving material,
- 100 mm (4") of 15 MPa (2200 psi) Portland cement concrete, or
- Type S roll roofing, or
- 0.10 mm (4 mil) polyethylene each weighted down and with joints lapped at least 100 mm (4").

Looking Ahead

Chapter 6, Fire Protection
for crawl spaces used as warm air plenum and protection of foamed plastics

Chapter 13, Insulation

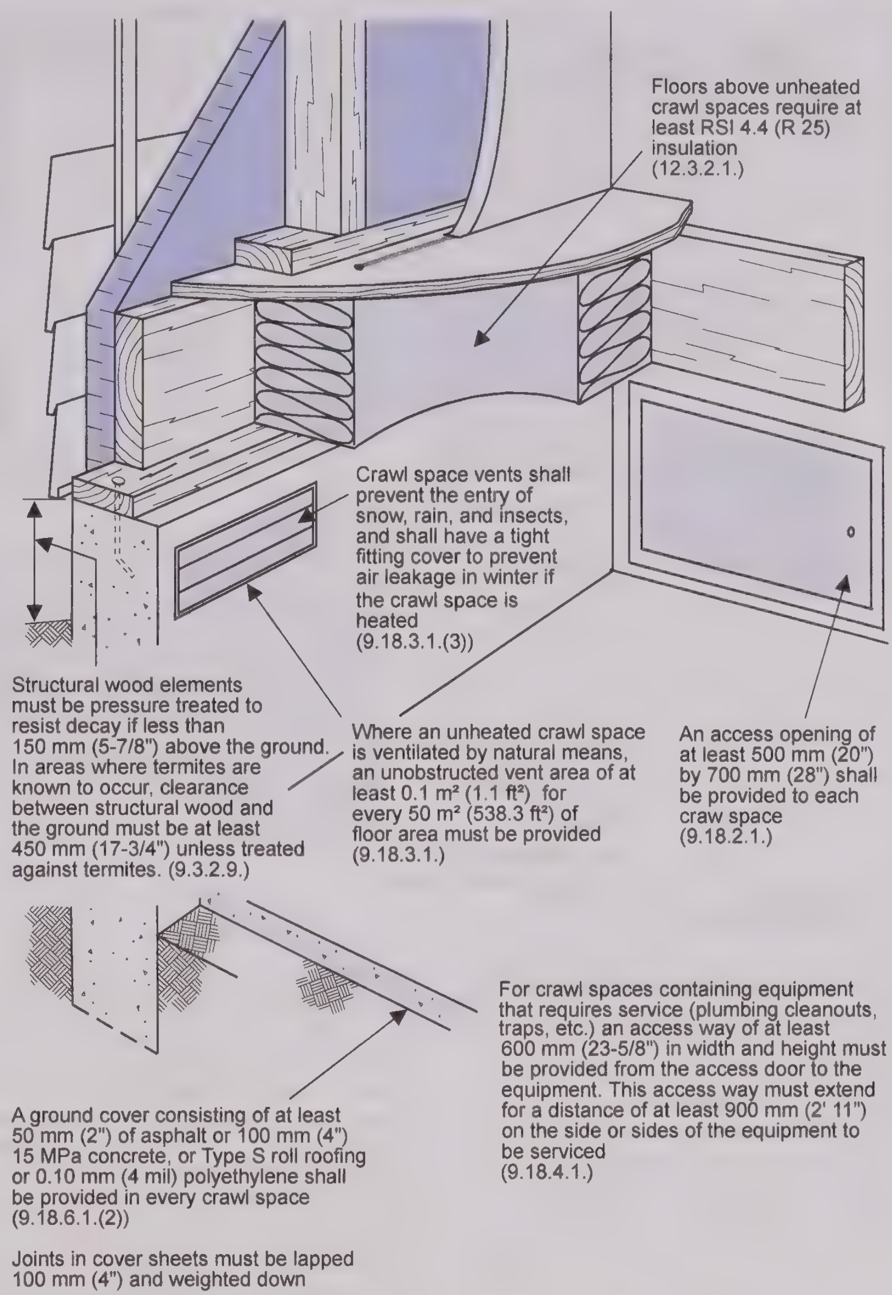


Figure 2.35
Unheated Crawl Spaces (9.18.)

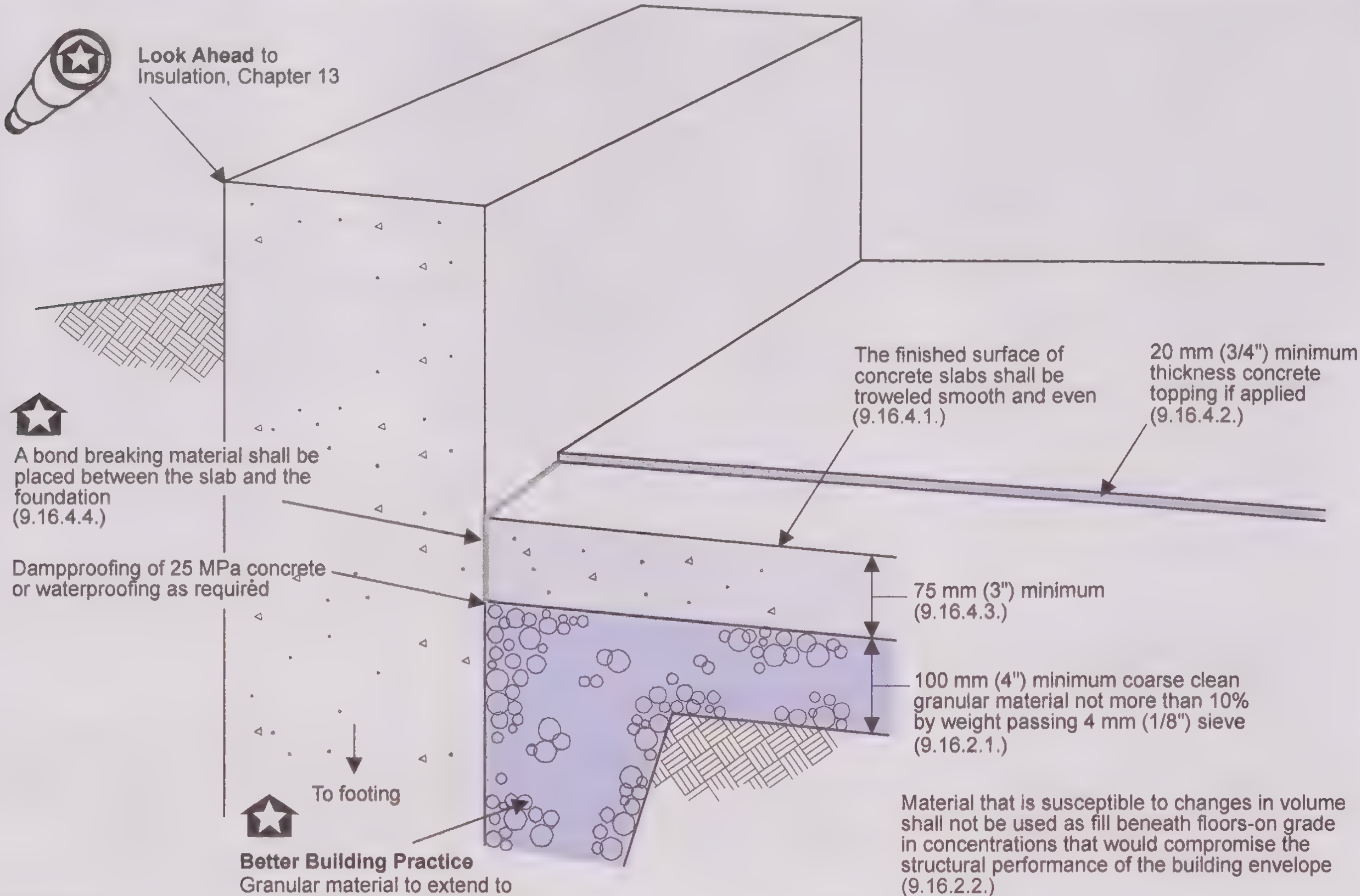


Figure 2.36
Floors-On-Ground

FLOORS-ON-GROUND

BUILDING CODE REFERENCES

DIVISION B

9.8.8.1.	Required Guards
9.16.1.1.	Application
9.16.1.2.	Structural Floor Slabs
9.16.1.3.	Required Floors-on-Ground
9.16.1.4.	Dampproofing and Water proofing
9.16.2.1.	Required Installation of Granular Fill
9.16.2.2.	Support of Floors
9.16.4.1.	Surface Finish
9.16.4.2.	Topping Course
9.16.4.3.	Thickness
9.16.4.4.	Bond Break
9.16.5.1.	Wood Frame Floors

All accessible spaces over ground within dwelling units, with the exception of crawl spaces, must have a floor-on-ground made out of wood or concrete. Slabs-on-ground do not provide support for the building structure above. Where floor slabs support the superstructure they must be designed according to Part 4 of the Code.

Not less than 100 mm (4") of coarse, clean, granular material containing not more than 10% of material that will pass a 4 mm (1/8") sieve is required under floors-on-ground, except for those in carports, garages, and accessory buildings. This material facilitates depressurization beneath the slab to remove soil gases should they occur and cause any problems. Material that is susceptible to changes in volume due to variation in moisture content, freezing temperatures or chemical-microbiological oxidation must not be used as fill beneath floors-on-ground in quantities that will damage a building or threaten stability or performance.

A bond-breaking material must be provided between the slab and footings or rock in order to allow for movement between the slab and foundation. Dampproofing according to Section 9.13. must also be provided (see Figure 2.42). The minimum thickness for concrete slabs-on-ground is 75 mm (3"). The concrete must be trowelled smooth and even. When floor drains are installed, the floor surface must be sloped to the drains to prevent the accumulation of water. Figure 2.36 summarizes the important requirements for floors-on-ground.

When slabs are at grade, minimum insulation requirements and the proper sealing of joints is required. Refer to Chapter 13 for insulation, air barrier and vapour barrier requirements.

Floors-on-ground can also be constructed of wood. These types of floors must conform to CAN/CSA-S406, "Construction of Preserved Wood Foundations", and are normally designed under Part 4 of the Building Code.

PIER FOUNDATIONS

BUILDING CODE REFERENCES

DIVISION B
9.4.1.1. General
9.15.2.3. Pier Type Foundations
9.20.11.6. Piers

Where pier foundations are used, they must be designed to support the applied loads from the superstructure. The requirements for pier foundations are illustrated in Figure 2.37. Piers are expected to support the principal framing members and must not be spaced more than 3.5 m (11' 6") apart along the framing, unless the piers and their footings are designed for larger spacing. As well, their height must not exceed three times their least dimension at the base of the pier. Where these limitations are exceeded, piers must be designed according to Part 4 of the Code.

When concrete block is used for the pier, the units must be laid with cores placed vertically. In buildings that are less than 4.3 m (14' 1") wide, blocks must be placed with their longest dimension at right angles to the longest dimension of the building. Anchor bolts placed in the tops of masonry piers shall conform to Part 4 of the Code.

Where permafrost is present the Code requires that foundations must be designed using Part 4 of the Code.

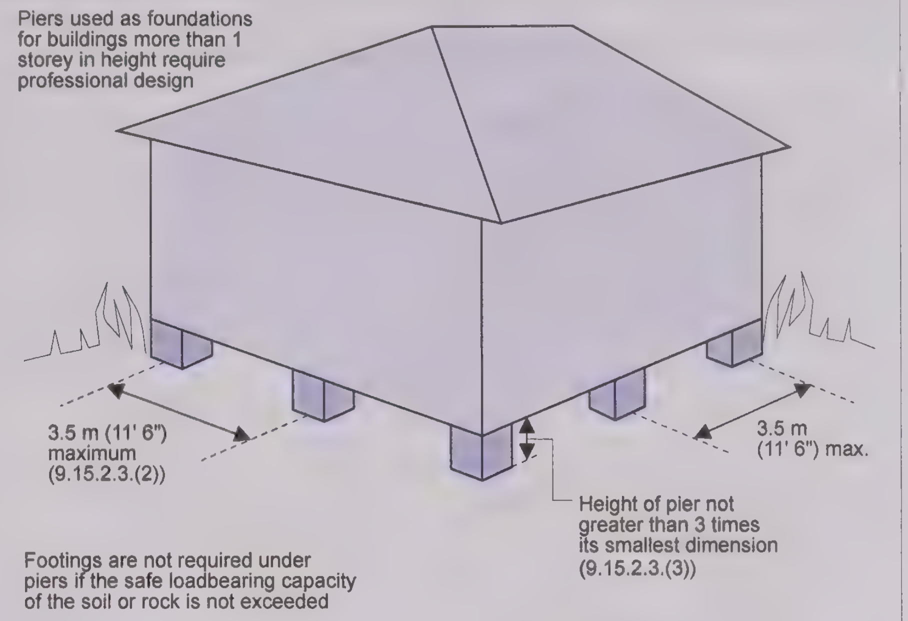


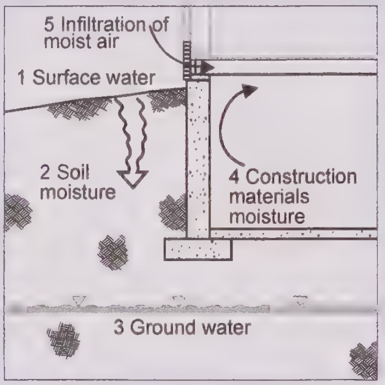
Figure 2.37
Pier Type Foundation in Buildings of 1 Storey (9.15.2.3.)

Moisture Control

The control of moisture in foundations is needed to prevent the short term damage and nuisance associated with water leakage and to protect the long term integrity of the building structure. Measures used in the control of moisture may also help prevent the entry of soil gas, including radon, in basements.

There are five sources of moisture associated with foundations:

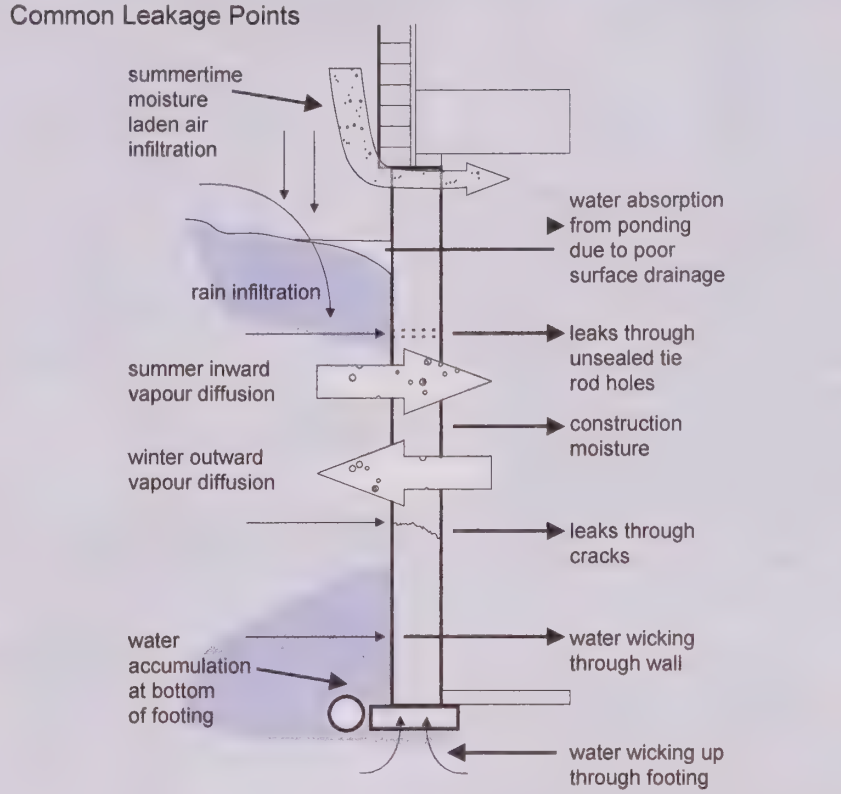
1. surface water (infiltration)
2. soil moisture (dampness and water vapour)
3. ground water
4. construction materials moisture
5. infiltration of moisure-laden air



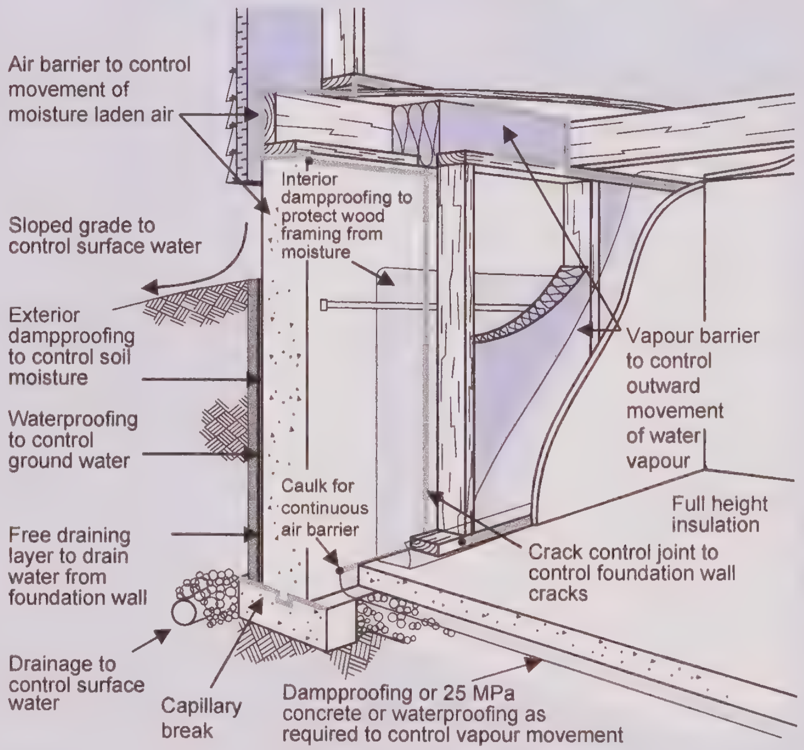
Surface water from rain and snow-melt is controlled through the use of eavestroughing, grading and drainage. Soil moisture, in the form of capillary water or water vapour, is controlled by the application of dampproofing materials. Ground water may be controlled either by the application of waterproofing combined with a structural design capable of resisting water pressures, or by providing water pressure relief and conveyance, usually to a sump where it may be pumped away from the building.

Construction moisture - water in concrete - is best controlled by allowing adequate drying time. Trapped construction moisture may cause decay and mold of susceptible materials.

Common Leakage Points



Below is an illustration of a sequenced approach to controlling moisture.



PARGING AND FINISHING

BUILDING CODE REFERENCES

DIVISION B

9.13.2.4.	Preparation of Surface
9.13.3.4.	Preparation of Surface
9.15.6.1.	Foundation Walls below Ground
9.15.6.2.	Foundation Walls above Ground
9.15.6.3.	Form Ties

Concrete block foundation walls must be rendered, parged or suitably finished for the following reasons:

1. Above grade walls must be parged or finished to reduce the likelihood that water does not penetrate through cracks, holes or recesses. Before parging,care must be taken to remove form ties and to seal ties rod holes to create a uniform concrete surface.

2. Below grade concrete block walls must be parged before damp-proofing is applied in order to fill joints and provide a smooth surface comparable to solid concrete finish.

3. Where below grade walls are to be waterproofed, the exterior surfaces must be parged or sealed smooth to prevent accumulations of water and possible rupture of the water proofing material at sharp edges or openings.

Proper parging and surface finishing are the first step in controlling moisture penetration through foundation walls. Refer to Figures 2.38 and 2.39.

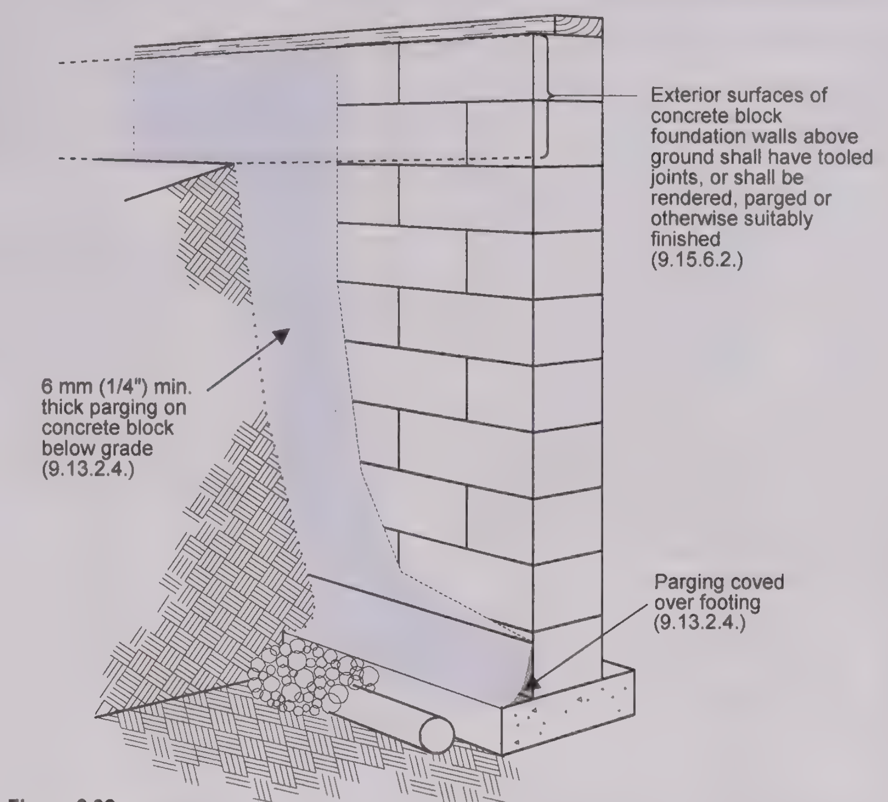


Figure 2.38
Parging Unit Masonry

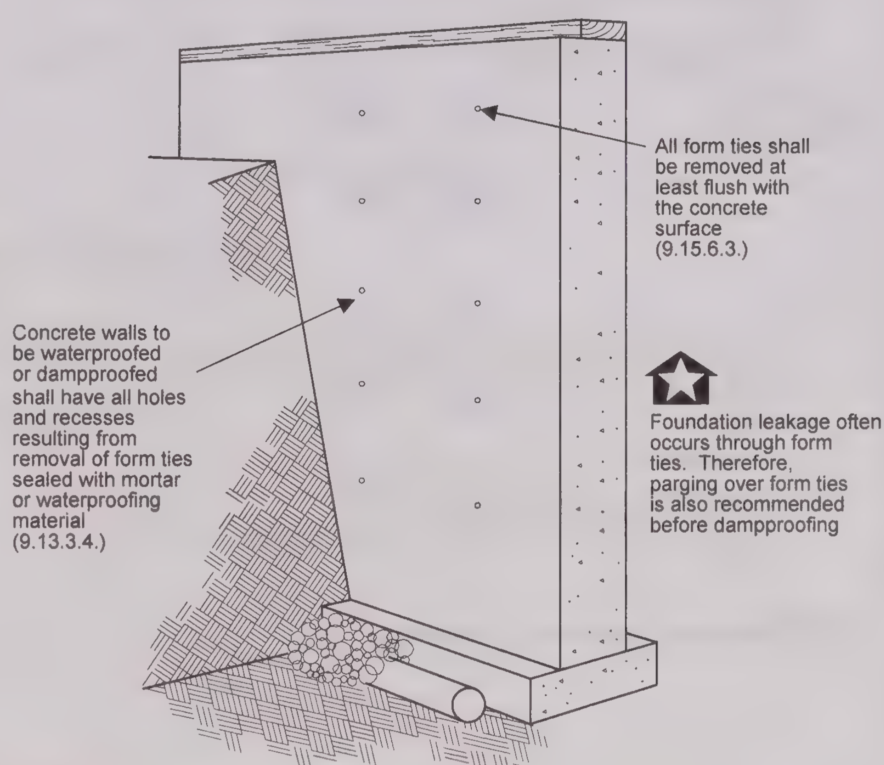


Figure 2.39
Dampproofing Concrete Walls

DAMPPROOFING

BUILDING CODE REFERENCES

DIVISION B

9.13.2.1.	Dampproofing
9.13.2.2.	Material Standards
9.13.2.3.	Standards for Application
9.13.2.4.	Preparation of Surface
9.13.2.5.	Application of Dampproofing Material
9.13.2.6.	Moisture Protection for Interior Finishes
9.13.2.7.	Dampproofing of Floors-on-Ground
9.13.2.8.	Dampproofing of Preserved Wood Foundation Walls
9.16.4.5.	Compressive Strength

Dampproofing is provided to control the water wicking from the soil into the exterior block or concrete walls. Dampproofing controls soil moisture ingress through walls and floors in contact with the ground. Figure 2.40 illustrates a dampproofed exterior wall.

Dampproofing is not intended to control bulk water from either the ground surface or water table. These two moisture sources are controlled by foundation drainage and/or waterproofing. Figure 2.41 illustrates the Code requirements for exterior foundation dampproofing.

Dampproofing applied over footings to prevent rising dampness from footings through foundation walls is a good building practice but is not required by the Code. As well, dampproofing is not required where the exterior surface of foundation walls below ground level is waterproofed. Figure 2.42 identifies the requirements for interior and exterior dampproofing of foundations.

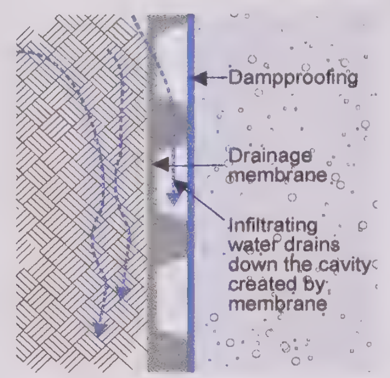
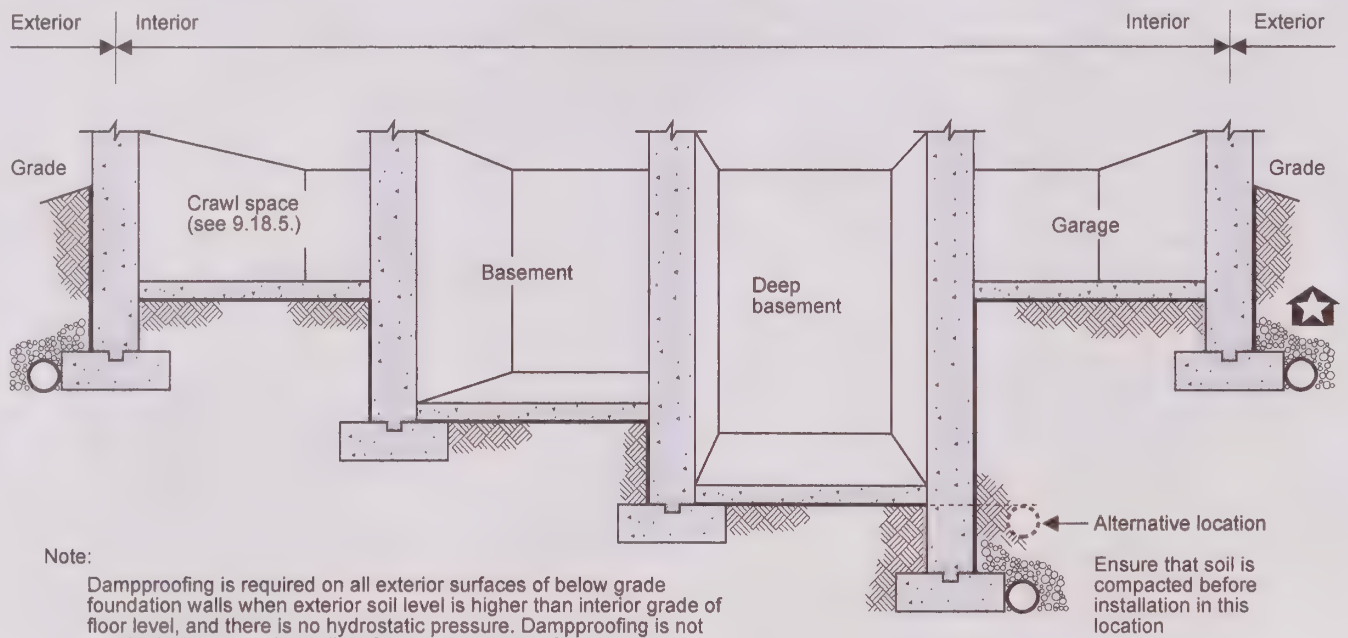


Figure 2.40 (9.13.2.)
Dampproofing and Drainage Layer Detail



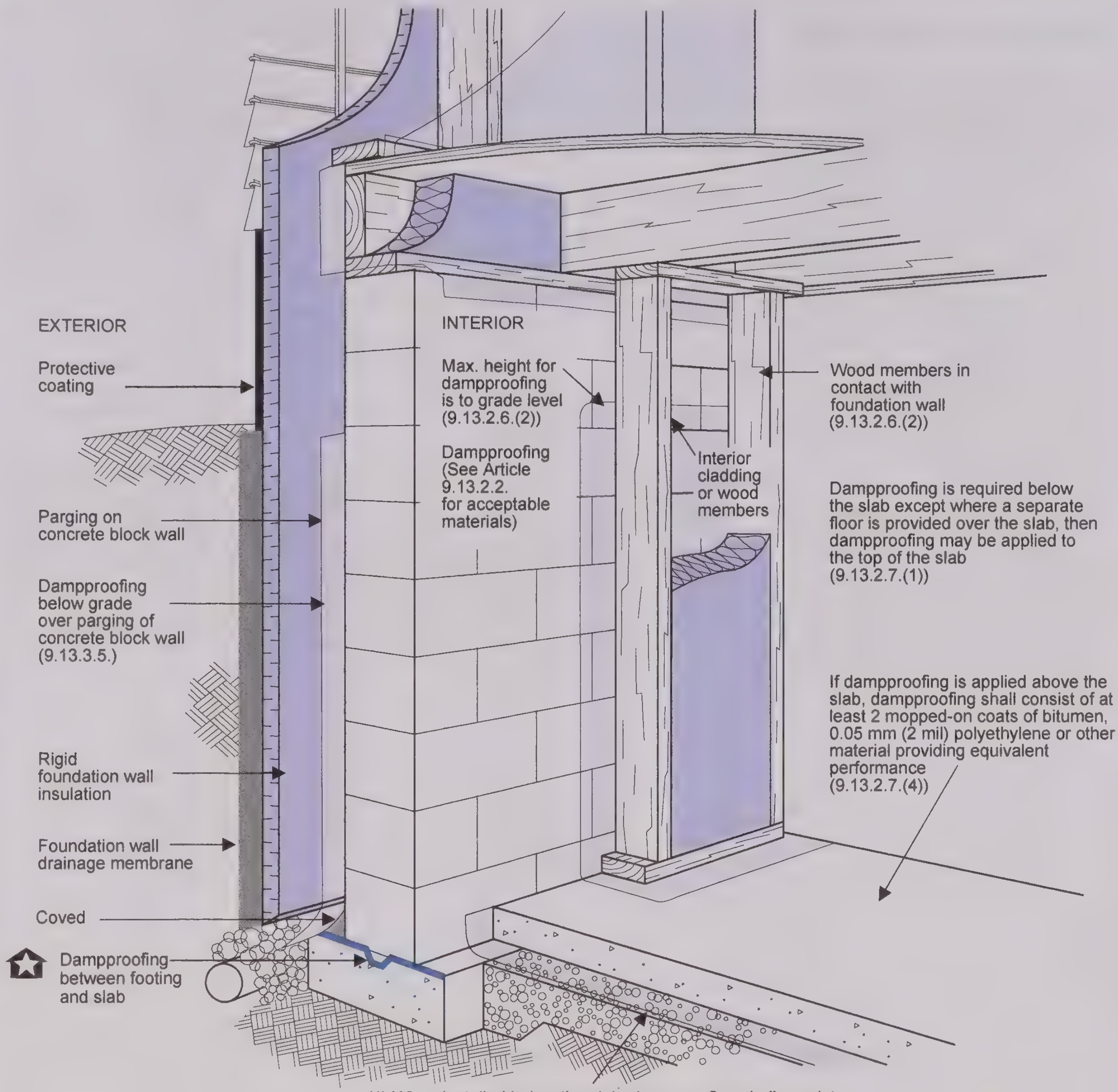
Note:

Dampproofing is required on all exterior surfaces of below grade foundation walls when exterior soil level is higher than interior grade of floor level, and there is no hydrostatic pressure. Dampproofing is not required where exterior wall surfaces are waterproofed (9.13.2.1.).

The water/cement ratio must meet CAN/CSA-A438 per Article 9.3.1.1.

Dampproofing is required for all floors-on-ground. Where dampproofing is not provided for concrete slabs-on-ground, the concrete used shall have a compressive strength of not less than 25 MPa (3600 psi) after 28 days (9.16.4.5.)

Figure 2.41
Exterior Foundation Dampproofing and Drainage (9.16.4.5.)



(1) When installed below the slab, dampproofing shall consist of polyethylene not less than 0.15 mm thick (6 mil) (9.16.4.5.)

Dampproofing is not required if 25 MPa (3600 psi) concrete is used (9.16.4.5.)

(2) If dampproofing membrane is required, joints in dampproofing shall be lapped not less than 100 mm (4") (9.13.2.7.)

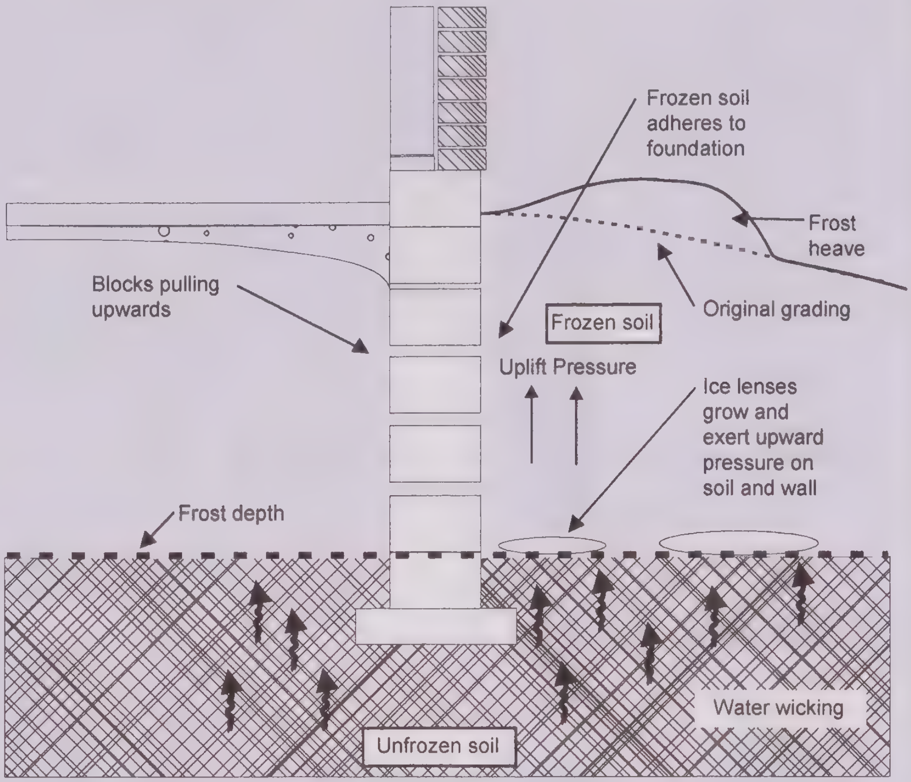
Figure 2.42
Dampproofing Unit Masonry

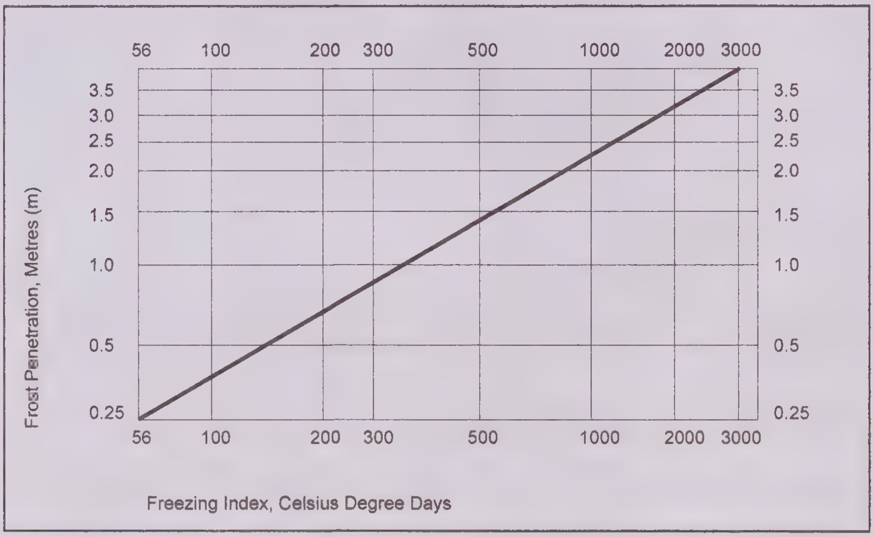
(9.13.)

Frost Heave & Adfreezing

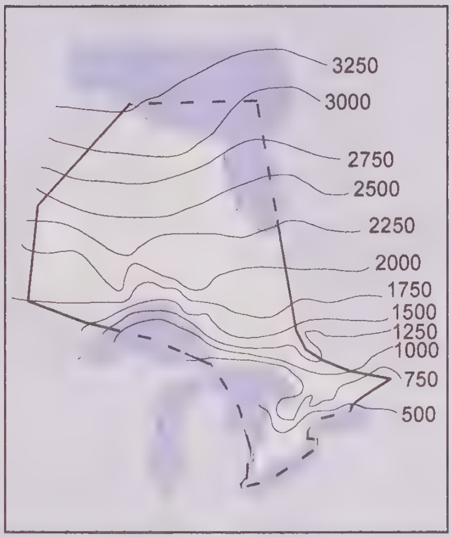
Moisture in soil can move upwards through gaps between the soil particles, using surface tension through a process known as capillary action. Capillary action can lift large volumes of water great distances. When water rises through soil in winter, it reaches a point where low temperatures cause it to freeze. In fine grained soil at the freezing plane, water in the soil freezes into ice lenses. Water is drawn to the ice lens by wicking or capillarity from the unfrozen soil. Ice lenses are generally able to exert a sizeable uplifting, or "heaving" force on soil or structures on top of the lens. This can lead to significant cracking.

Placing the footing below the frost line is the normal defense against frost heave. However, the upward thrust of the growing ice lenses can be transferred to the building if the frozen soil adheres in any way to the building (adfreezing). The forces of the soil heaving transferred to the building by adfreezing can cause the entire building to shift.





Frost depth by freezing index. It should be noted that foundation depths may be decreased where local experience has consistently shown that frost depths are less than the statistical estimates. Reference: Tarion Warranty Corporation, *Soils Manual for Home Builders*, North York: 1996.



Freezing index contours. Reference: Tarion Warranty Corporation, *Soils Manual for Home Builders*, North York: 1996.

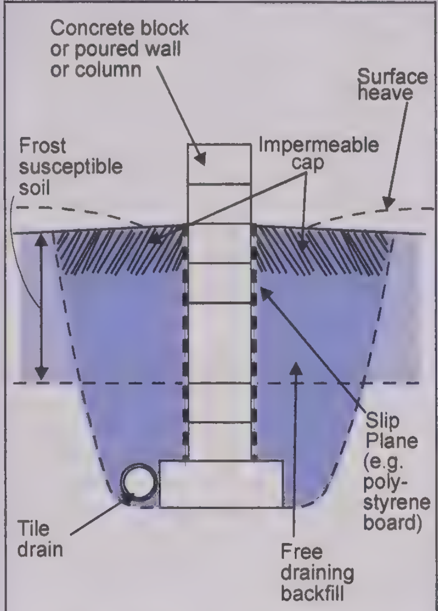
Frost Heave & Adfreezing (Continued)

The shifting of the building can result in cracked interior finishes and windows, stuck windows and doors, basement floor or wall cracks. In concrete block foundations adfreezing can be particularly disastrous as it can pull the individual blocks apart.

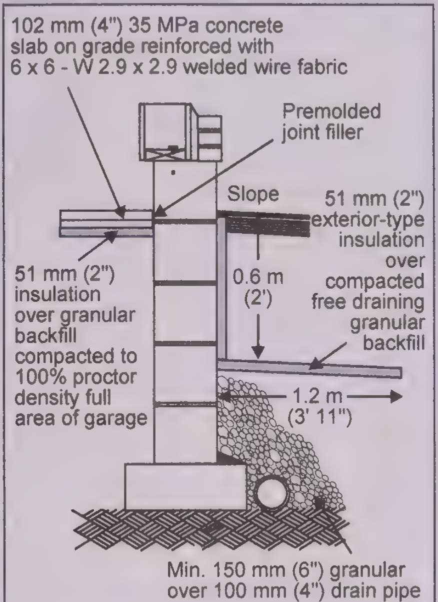
Adfreezing is most common for unheated structures. It is less common for heated basements to experience adfreezing because heat loss prevents the immediate surrounding soil from freezing. However, if the foundation wall heat loss is reduced enough so that the immediate surrounding soil freezes, adfreezing can occur.

Three conditions are required for frost heaving to occur. Soil must be frost susceptible, water must be available in sufficient quantities, and temperatures must be below freezing. Eliminating any of these things will prevent soil heaving.

To ensure proper adfreezing protection, a bond break that allows soil to slide against the building can be used. Rigid insulation, a layer of free draining backfill, polyethylene or a drainage layer placed between the the foundation and the soil can minimize the damage due to adfreezing.



Properly backfilled and drained foundation wall or column. Note how surface heave still happens, but is kept away from the foundations by a loose backfill which allows run-off water to drain down below the depth of the frost susceptible soil



Insulation around foundation wall and over compacted backfill. This design traps heat below the slab and foundation to prevent freezing. To determine extent of insulation for your geographical area, refer to a design professional.

Sources:

Penner, E. *Ground Freezing and Frost Heaving*. NRC-IRC Publications. Canadian Building Digest, February 1962.

Penner, E and K.N. Burn. *Adfreezing and Frost Heaving of Foundations*. NRC-IRC Publications. Canadian Building Digest, August 1970.

FOUNDATION AND SURFACE DRAINAGE

BUILDING CODE REFERENCES

DIVISION B

9.14.1.1.	Application
9.14.1.2.	Crawl Spaces
9.14.1.3.	Floors-on-Ground
9.14.2.1.	Foundation Wall Drainage
9.14.3.1.	Material Standards
9.14.3.2.	Minimum Size
9.14.3.3.	Installation
9.14.4.1.	Type of Granular Material
9.14.4.2.	Installation
9.14.4.3.	Grading
9.14.4.4.	Wet Site Conditions
9.14.5.1.	Drainage Disposal
9.14.5.2.	Sump Pits
9.14.5.3.	Dry Wells
9.14.6.1.	Surface Drainage
9.14.6.2.	Drainage away from Wells or Leaching Beds
9.14.6.3.	Window Wells
9.14.6.4.	Catch Basin
9.14.6.5.	Downspouts
9.16.3.1.	Control of Water Ingress
9.16.3.2.	Hydrostatic Pressure
9.16.3.3.	Floor Drains

The drainage of water from the ground surface and away from foundations is a key aspect of moisture control. Most water leakage problems in buildings arise during the spring snowmelt or periods of heavy or prolonged rainfall, such as the spring or fall. Surface drainage consists of conveying water which is shed by the building, or accumulates near it during snowmelt, along the ground. Sloping the earth away from buildings is the easiest way of improving surface drainage. However, some surface water will usually percolate through the soil in the vicinity of the foundation.

The drainage of this infiltrating water is necessary to prevent the water adjacent to the foundation from penetrating the foundations. Installing perforated drainage tile around the outside footing perimeter facilitates drainage of infiltrating water away from the foundation and prevents it from getting inside the basement.

The perimeter drain must be covered with no less than 150 mm (5-7/8") of clear stone (less than 10% fine) or similar coarse grained material in accordance with the Code requirements.

A drainage layer must also be provided adjacent to the exterior surface of the foundation wall. This may take the form of a continuous layer of mineral fibre insulation, free draining granular or a drainage membrane all of which must extend down to the footing level. Figure 2.43 illustrates these requirements.

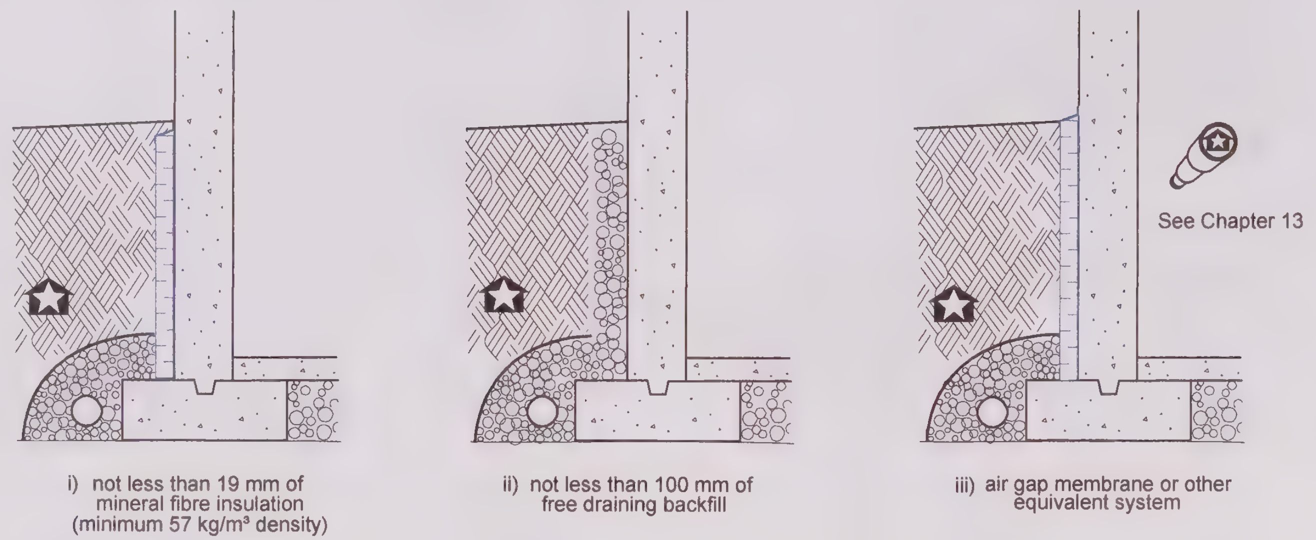


Figure 2.43
Foundation Wall Drainage Options (9.14.2.1.)

Foundation Drainage

All foundation walls below grade (not subject to hydrostatic pressure) must be dampproofed or waterproofed.

Where waterproofing is not provided or where dampproofing is not required, foundation walls must be provided with a water drainage layer that helps to take infiltrating surface water to the foundation's drainage system. Foundation drainage layers are also useful capillary breaks helping to control the ingress of soil moisture.

The Code permits:

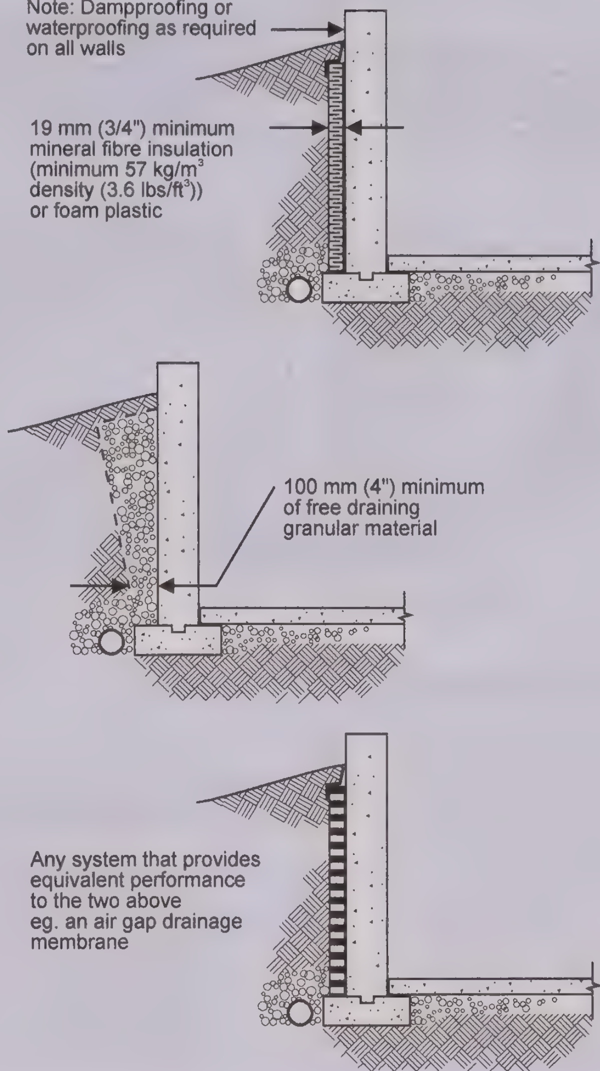
1) a 19 mm (3/4") minimum layer of mineral fiber insulation (minimum 57 kg/m³ density (3.6 lbs/ft³))

2) a 100 mm (4") minimum layer of free draining granular material, or

3) any system that provides equivalent performance to the above two, applied to the inside or outside face of the foundation wall, such as an air gap drainage membrane.

(9.14.2.1.)

The drainage layer must be installed on the exterior face of insulation that may be applied to the outside of the foundation wall.



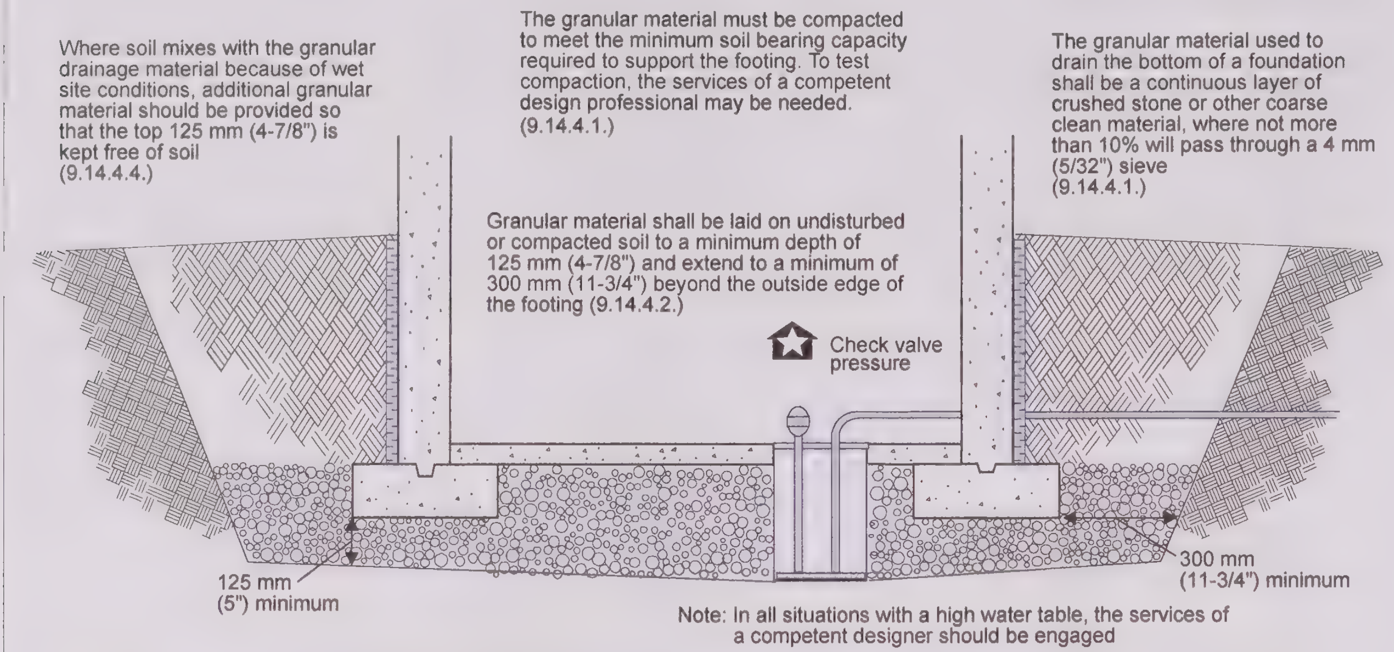


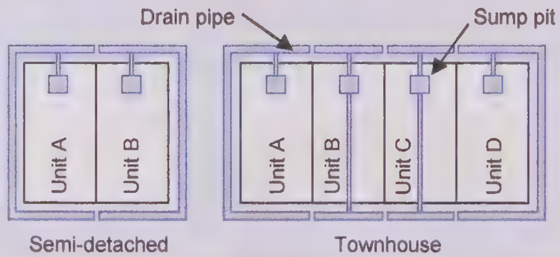
Figure 2.44
Alternative Foundation Drainage (9.14.4.)

Ground water from a high water table is discussed on the pages that follow. In some cases a compacted, granular drainage layer beneath the basement or crawl space footings and floor slab may also be used as shown in Figure 2.44 to avoid the many issues a high water table creates. In these situations, the ground water must drain away from the lowest point in the foundation. Where this is not possible, a sump must be constructed which permits the water accumulated to be pumped away. It is important that the ground water be transferred to a location that has sufficient capacity.

An overview of foundation and surface drainage has been provided in Figures 2.45, 2.46, and 2.47.

Foundation Drainage for Semi-Detached and Townhouses

Where sump pits are connected to drain pipe, the drain pipe for each house should be separated from connecting dwellings. The pipe should be capped at the ends.



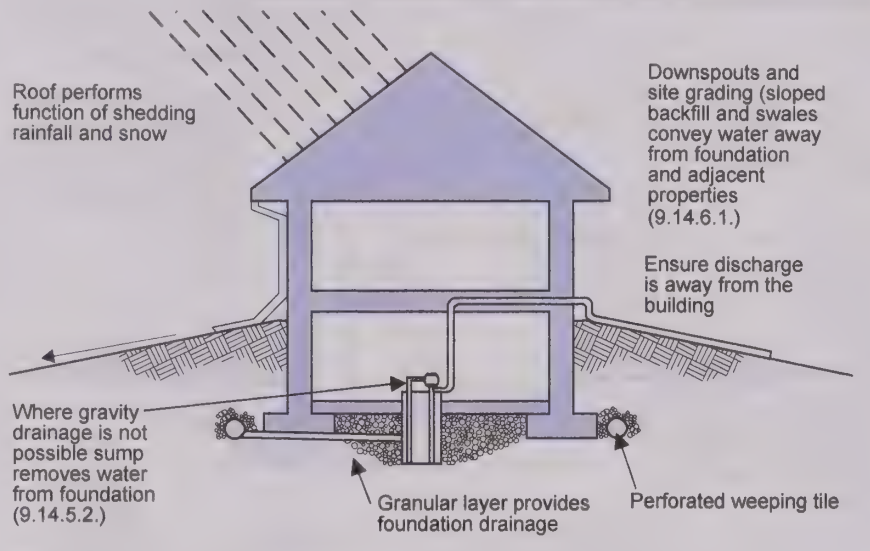


Figure 2.45
Surface and Foundation Drainage (9.14.2.1.)

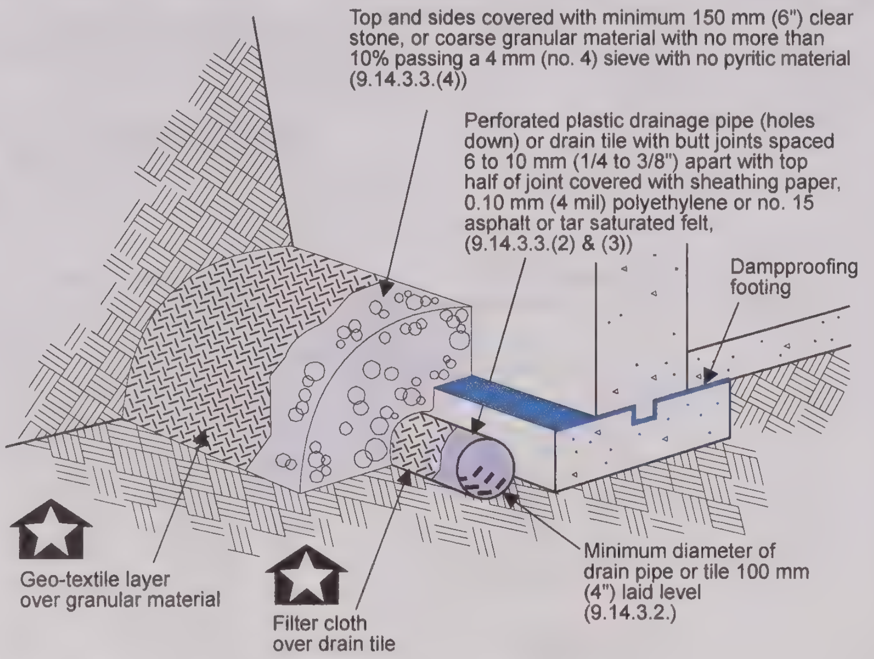


Figure 2.46
Drain Tile or Pipe Used for Foundation Drainage

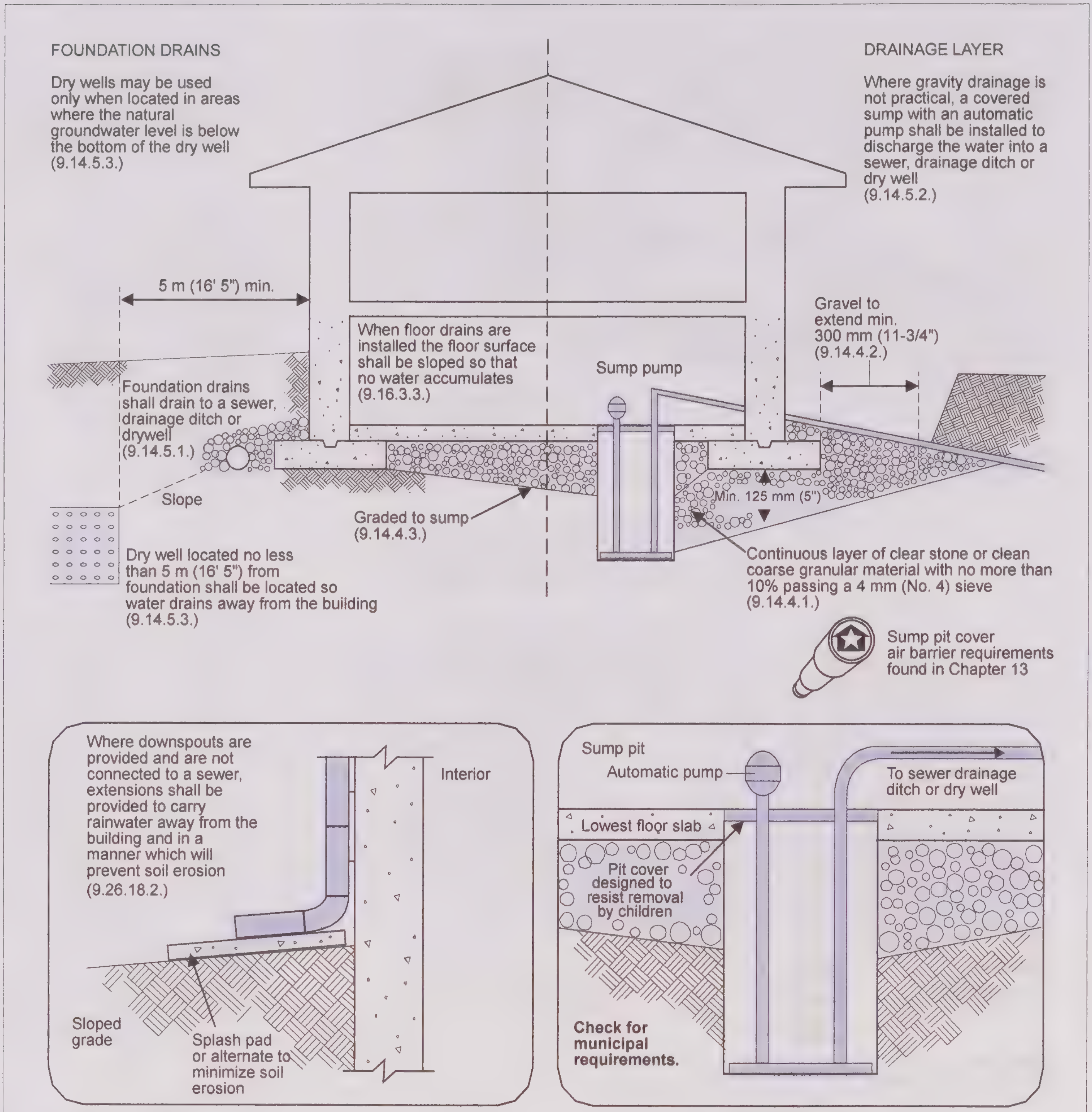


Figure 2.47
Drywells and Drainage

(9.14.4.)
(9.14.5.)

WATERPROOFING

BUILDING CODE REFERENCES

DIVISION B

9.13.3.1. Required Waterproofing
9.13.3.4. Preparation of Surface
9.13.3.5. Application of Waterproofing Membranes
9.13.3.6. Floor Waterproofing System

Steps must be taken where a high water table imposes a hydrostatic pressure on building elements. Where the exterior finished grade is higher than interior ground level and a high water table exists, floors-on-ground, roofs of underground structures and below grade walls must be waterproofed.

Waterproofing is best applied to smooth, uniform surfaces. Accordingly, unit masonry foundation walls must be parged,solid concrete walls must be sealed of all holes and cracks, and insulating concrete form walls must be repaired with no projections and depressions. Requirements for the waterproofing of floors and walls are illustrated in Figure 2.48. Where hydrostatic pressure occurs beneath the floor slab, a means of relieving this pressure must be provided or the slab must be designed to resist uplift pressures.

Extreme care must be taken to ensure compatibility between insulation on ICFs and waterproofing dampproofing membranes.

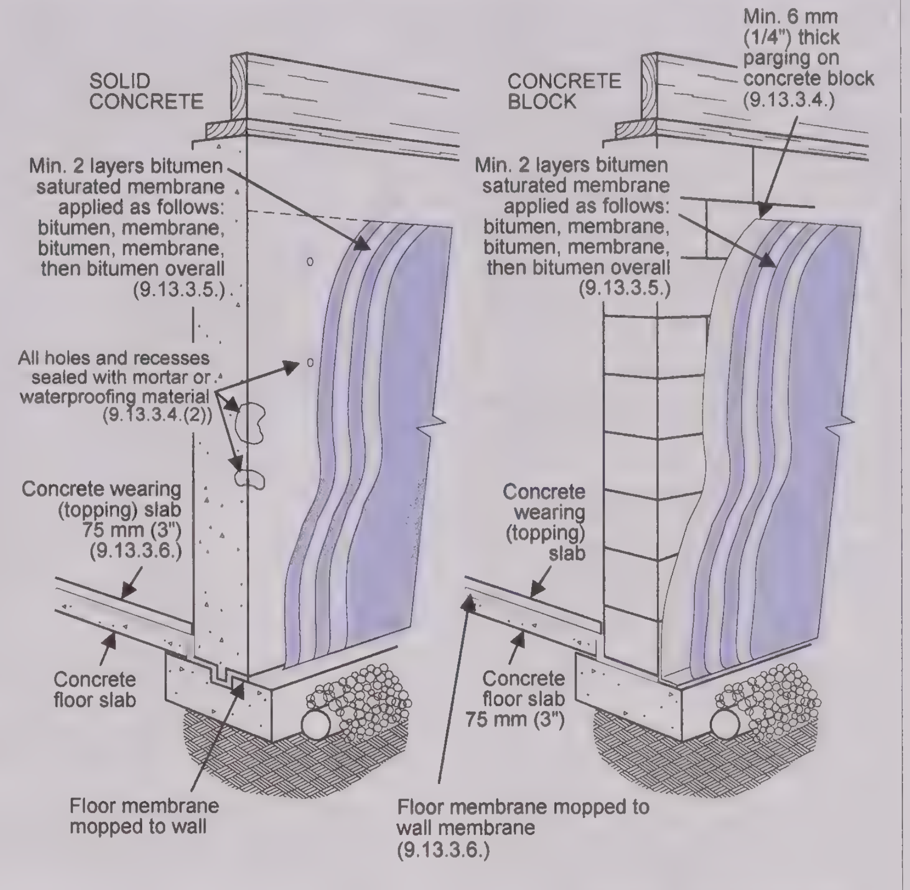


Figure 2.48
Waterproofing Foundations

BACKFILLING

BUILDING CODE REFERENCES

DIVISION B

9.12.3.1	Placement of Backfill
9.12.3.2	Grading of Backfill
9.12.3.3	Deleterious Debris and Boulders
9.12.3.4	Lateral Support of Foundation Wall

Backfilling is one of the final steps in completing the foundation system. Deleterious materials and boulders larger than 250 mm (10") in diameter must be removed from within 600 mm (23-5/8") of the foundation prior to backfilling. Pyritic material or materials that are susceptible to dimensional change must not be used as backfill. As well, materials that may be susceptible to ice lensing must also not be used as backfill (e.g. silty soils). Where the foundation wall requires lateral support (see Article 9.15.4.2.), or the required concrete strength has not been reached, foundation wall bracing or lateral support is required (See Figure 2.49).

Proper backfilling loads the structure in such a way that the weight of the soil is safely distributed throughout the foundation. This involves backfilling first at the corners (proceeding around the foundation in a clockwise pattern), then along the shorter walls, and finally along the longer sections. This practice will help prevent stress cracking during backfill, which can allow water penetration.

Care must be taken during backfilling to avoid damage to the drainage tile, the foundation wall, the externally applied thermal insulation and the waterproofing membrane. Boulders and debris must not be included with backfill materials within 600 mm (23-5/8") of the foundation walls. Backfill material should be placed gradually and uniformly in small lifts and compacted to an appropriate density. Heavy machinery, construction equipment, and skids of building materials should be kept at an adequate distance from the foundation to avoid surcharge loading of the foundation walls.

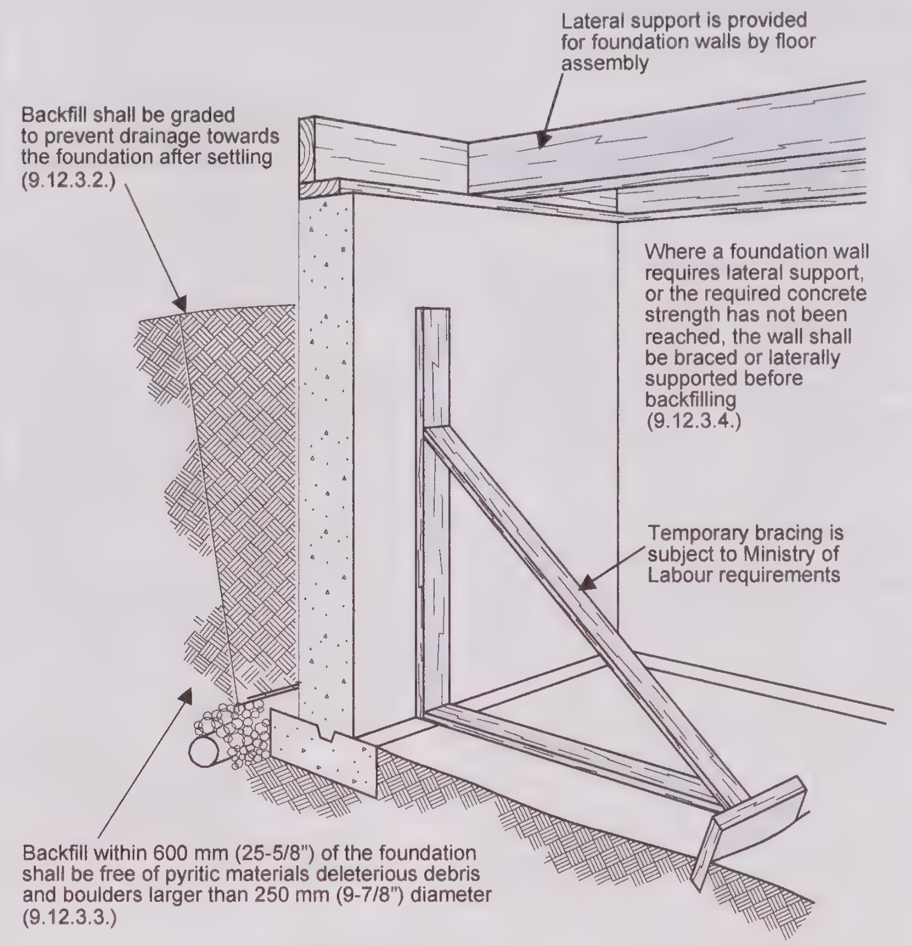
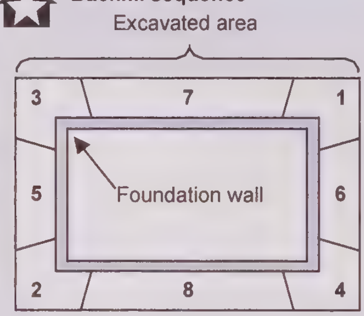


Figure 2.49
Lateral Support (9.12.3.)

Backfill sequence

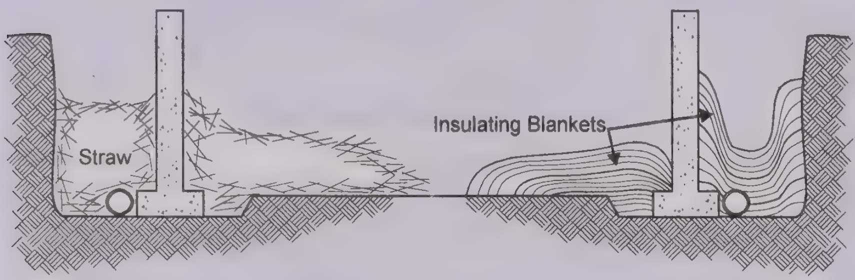


Deleterious
harmful often in a subtle or unexpected way

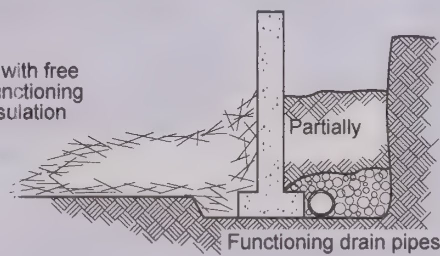
Pyritic
any of various metallic-like sulfides where pyrite is the most common

Pyrite
a pale brass-yellow mineral commonly known as 'fool's gold'

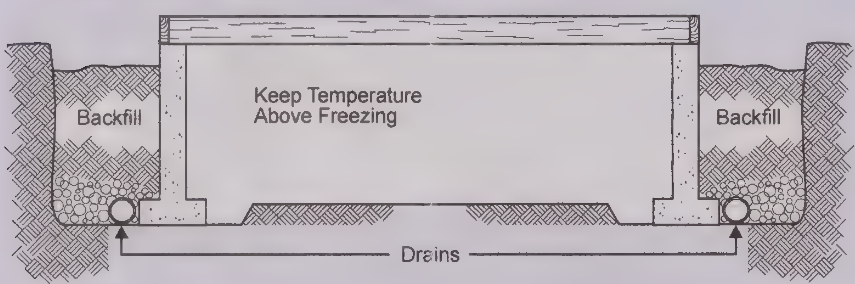
Open foundations can be protected with a sufficient thickness of straw or insulating blankets, extending to four feet on either side. The required thickness will depend on local climate. Review local practices. Wet straw or insulating blankets can lose its insulating properties, and will have to be replaced if not properly maintained. Install a drainage system to keep the excavation dry, and cover with straw and insulating blankets.



Foundations can be partially backfilled with free draining gravel or coarse sand - with functioning drainage. On the inside they require insulation with straw or blankets.



Once the main floor of the house is framed and anchored to the foundation, backfill and maintain temperature above freezing in the upper basement. As propane heat causes excessive condensation on subflooring and may promote carbonation (degradation) of the concrete, it is not recommended unless the space is vented.



Building in Cold/Wet Weather

Building in cold/wet weather, while not recommended, is at times unavoidable. The two main problems encountered are excessive water due to rain and spring thaw and freezing conditions during winter. High winds do not usually affect foundations, but bracing should be considered later once framing of walls and roofs takes place.

Some suggestions for building in bad weather have been provided below.

Managing Water in Excavations

When excessive amounts of water enter the excavation and accumulate at the bottom, the following measures are suggested:

1. drain the water away from the excavation, if possible.
2. pump out accumulated water.
3. wait until the water drains.

In all cases, avoid disturbing the bottom of excavations as much as practically possible until they have dried out.

Protecting Installed Foundations

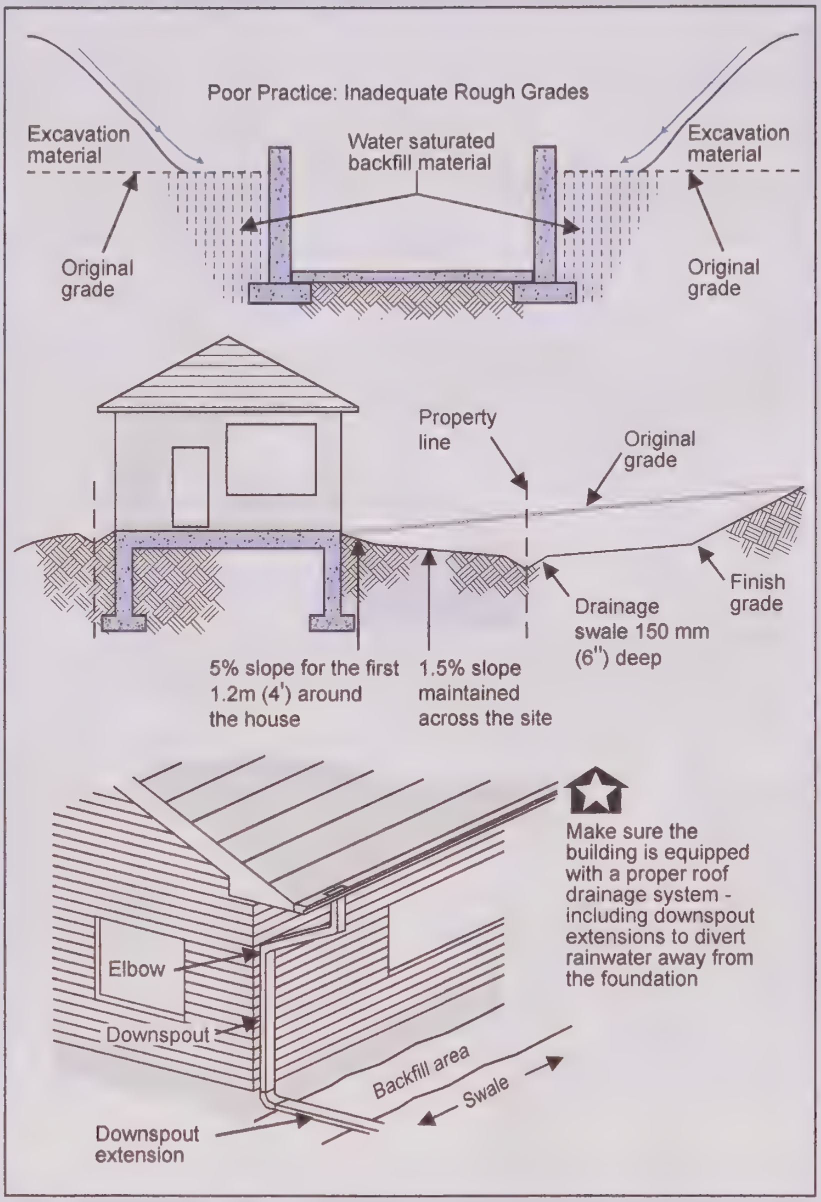
Foundations, and the soil beneath them, must not be allowed to freeze. When winter construction is undertaken, the measures depicted may provide adequate protection.

Site Drainage

Adequate site grading and drainage will help minimize potential water problems that might be experienced. The intention is to move water away from the house without affecting the adjacent buildings.

By observing some simple guidelines, potential water problems can be avoided:

- Maintain positive grade during construction and prevent water accumulation at foundation.
- A minimum 1.5% slope should be maintained across the entire site
- A slope of 5% should be maintained around the house for the first 1.2 m (4'), or to the edge of the property line, to a minimum depth of 15 cm (6").
- Swales should be dug a minimum of 150 mm (6") deep. Swales should slope away from the house and direct water away from private properties.
- Minimum finish grading should have a 150 mm (5-7/8") drop for the first 3 m (9' 10") away from the foundation (account for soil settlement).
- Install gutters with splash blocks or extensions to divert water away from the foundation.
- Install drain tiles to a minimum slope of 1:100.
- Installation of foundation drainage should be carefully installed and backfilling carefully supervised.
- Ponding near septic tank must be avoided.



Note
The requirements for connection of downspouts varies with municipalities. Check with your local building official.

SOIL GAS CONTROL

BUILDING CODE REFERENCES

DIVISION B
9.13.4.1. Soil Gas Control
9.13.4.2. Required Soil Gas Control
9.18.6.1. Ground Cover in Unheated Crawl Spaces
9.32.3.8. Protection Against Depressurization

Soil gases can affect occupants and the home. The Building Code recognizes radon and methane as the soil gases whose entry into the home must be controlled. Radon is a radioactive gas found in the soil in some parts of the province. Its presence can lead to serious health problems. Methane is an explosive gas. Where methane or radon is known to be a problem construction must conform to Supplementary Standard SB-9.

The following areas of Ontario have been found to contain a high level of radon 222 (a naturally occurring, radioactive substance found in the soil which can cause lung cancer), and due to the special measures needed to control radon, have been identified in the Code:

a) The Town of Elliot Lake in the Territorial District of Algoma,
b) The Township of Faraday in the County of Hastings, and,
c) The geographic Township of Hyman in the Territorial District of Sudbury.

Any buildings constructed in these areas or other areas not listed above but where methane or radon are known to be a problem (e.g. former landfill sites) must employ special measures to reduce allowable levels of methane and radon. The buildings must be designed and constructed so that the radon levels do not exceed 200 Bq/m³ of air. Consult the local building department for further information regarding acceptable practice.

When a dwelling unit is built in an area where methane or radon gases are known to be a problem, walls, roofs, and floor assemblies in contact with the soil must be built to resist the ingress of soil gas from the ground. Garages or unenclosed portions of buildings, buildings constructed with a sub-floor depressurization system described in Supplementary Standard SB-9 and in areas where it can be demonstrated that soil gas does not constitute a hazard are exempted from this requirement. Supplementary Standard SB-9 describes the requirements for soil gas control and is provided in the Code portion of this document; please refer to it for more information.

Wall Sealing

Walls which are required to provide a barrier to soil gas require a course of masonry units without voids, or flashing material that extends across the full width of the masonry. Masonry or flashing must be installed at or below the level of the adjoining floor slab, or, in the absence of a floor slab, at the level of the ground cover provided. In either case, the wall sealing membrane must be sealed to the floor or required ground cover. Refer to Supplementary Standard SB-9 for further details.

Floor Sealing

Where soil gas control is required, one of the following floor configurations must be used or in the case of single dwelling units, a sub-floor depressurization unit may be used. Where the floor-on- ground is a concrete floor slab, the soil gas barrier must be installed below the slab with joints lapped 300 mm (11-3/4"), or applied to the top of the slab with sealed joints and a separate floor installed above. When installed in conjunction with a framed floor-on-ground, the soil gas barrier must conform to the air barrier requirements of the Code. These requirements are discussed in Chapter 13 of this Guide.

Where the determined radon levels exceeds the Canadian Action Level for radon in indoor air, as specified in the Health Canada Guidelines (see Supplementary Standard SB-9). A sub-floor depressurization must be installed to reduce the concentration to acceptable levels.

Perimeter and Penetration Sealing

A floor on ground shall be sealed around its perimeter to the inner surfaces of adjacent walls with a flexible sealant, and all penetrations of floors-on-ground shall be sealed, including penetrations by hollow metal or masonry columns. Hollow columns are required to be sealed both at the perimeters, and in the centres. Those penetrations which are required to drain water from the floor surface shall be sealed to prevent the upward flow of soil gas without preventing the downward flow of water, such as with a trap seal. Refer to Figure 2.50. These provisions are part of the air barrier requirements that are detailed further in Chapter 13.

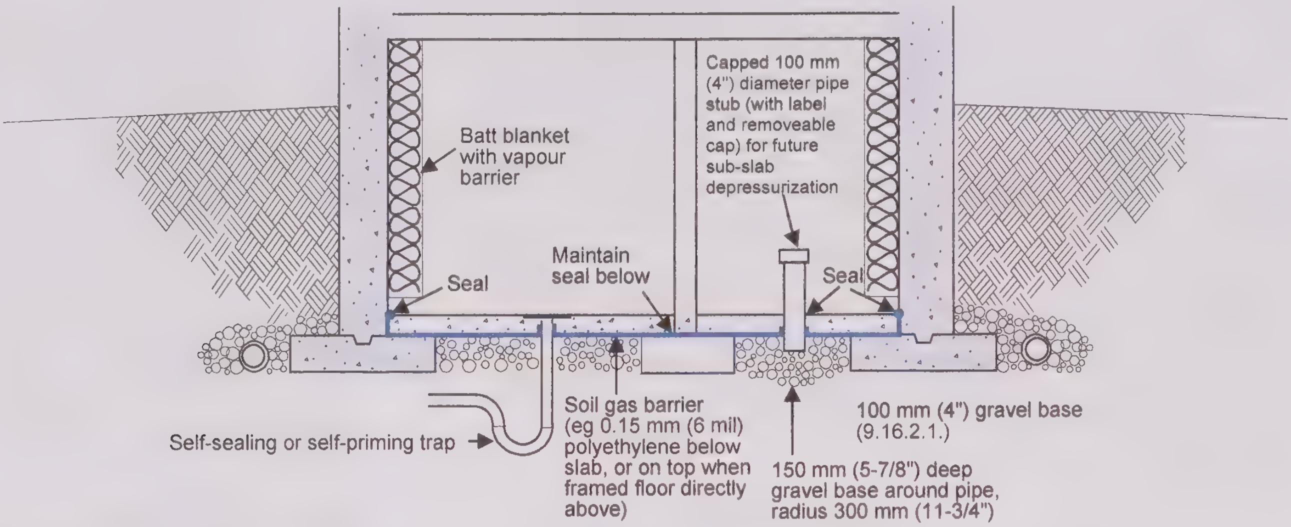


Figure 2.50
Foundation Sealing for Radon and Methane

(9.13.4.1.)

Sub-Floor Depressurization

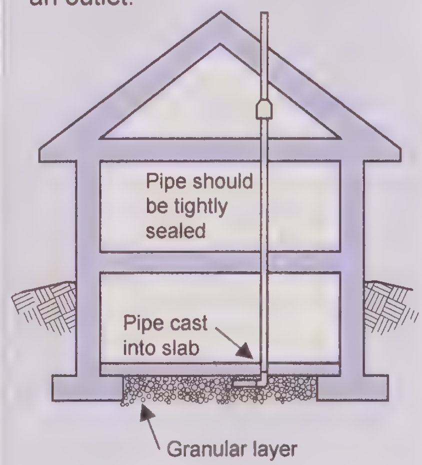
A soil gas barrier is permitted to be omitted where a single dwelling unit has been constructed to provide for sub-floor depressurization and has met the wall sealing requirements. Where a sub-floor depressurization system is installed to reduce the risk of radon ingress, make-up air need not be provided for mechanical exhaust equipment.

Granular material shall be installed below the floor on ground, according to Article 9.16.2.1. A pipe of 100 mm (4") in diameter must be installed vertically through the floor at or near its centre so that its bottom end opens into the granular fill and its top end will permit connection to depressurization equipment. The granular material must not be less than 150 mm (5-7/8") deep for a radius of 300 mm (11-3/4") centered on the pipe. The upper end of the pipe must be provided with a removable seal, and must be labeled to indicate that it is intended only for the removal of soil gases below the floor.

A sub-slab depressurization system must be tested after construction is complete according to Health Canada's publication, "Guide for Radon Measurements in Residential Dwellings (Homes), 2008" (see Supplementary Standard SB-9) to determine the radon concentration in the dwelling unit. A copy of the test results must be provided by the building owner to the local municipality.

Better Building Note

An active sub-slab depressurization system extends the rough-in pipe through the dwelling to discharge above the roof. The fan is installed outside of the living area near an outlet.



Builders should refer to Health Canada's publication *Guide for Reducing Radon Levels in Existing Homes: A Canadian Guide for Professional Contractors* for more information on radon mitigation systems.

3 FLOOR SYSTEMS

Floors in houses, in addition to supporting their own weight, must also support live loads that include those imposed by occupants, appliances, and furniture. Loads from other floors and sometimes from the roof and its snow loads can also be transferred through the floor system to the foundation walls. This chapter outlines the Code requirements for the framing of floor systems.

Floor system components in houses, such as beams, floor joists and floor sheathing are selected based on their ability to resist the superimposed loads. The ability to resist loads is determined by the component's strength and stiffness. The size and material used to make the components govern its strength and stiffness. The deflection requirements are intended to limit cracking of interior finishes under live loads and vibration from moving loads.

KEY POINTS

Floor framing in dwellings must be designed and constructed to fulfill the following functions:

- transfer loads to the building's structural elements;
- resist deflection and excessive vibration; and
- provide an acceptable surface for finished flooring materials.

LOADS AND DEFLECTIONS

BUILDING CODE REFERENCES

DIVISION B
9.4.1.1. General
9.4.2.1. Application
9.4.3.1. Deflections

Code requirements for housing apply to wood frame floors where framing members are spaced no more than 610 mm (24") apart. The design live loads for these floors cannot exceed 2.4 kPa (50 psf). Floors where these design conditions are exceeded must be designed to the requirements of Part 4 of the Building Code or be designed according to Canadian Wood Council's "Engineering Guide for Wood Frame Construction" or equivalent good engineering practices. This includes those instances where specified loads, member sizes, spans, and roof areas and obstructions fall beyond the scope of the conditions contained in Part 9 of the Code. Other limitations are identified in Article 9.23.1.1.

Floor components in houses are limited to a deflection which is 1/360 of the clear span of the component regardless of the type of ceiling finish. For example, for a clear span of 4.6 m (15'), this requirement translates into a 12.7 mm (1/2") deflection at centre span.

Dead and Live Loads

Dead loads generally act vertically downward on a structure and include the self-weight of the structure and the weight of building elements, fixtures, services and mechanical equipment permanently attached to it.

Live loads generally act vertically downward on a structure resulting from occupants, furniture and stored materials. Live loads also include rain and snow load accumulation on roofs and balconies.

FLOOR SYSTEM ANCHORAGE

BUILDING CODE REFERENCES

DIVISION B
9.20.11.1. Anchorage of Floor or Roof Assemblies
9.23.2.2. Protection from Decay
9.23.2.3. Protection from Dampness
9.23.6.1. Anchorage of Building Frames
9.23.6.3. Anchorage of Smaller Buildings
9.23.7.1. Size of Sill Plates
9.23.7.2. Levelling of Sill Plates
9.23.9.1. End Bearing for Joists
9.23.11.2. Bottom Wall Plates

Floor systems must be anchored to the foundation to resist uplift and lateral forces that can result from wind and other superimposed loads. Anchorage can be omitted where structural analysis shows it to be unnecessary. The floor system can be embedded in the foundation wall or it can be anchored through a sill plate connected with anchor bolts to the foundation. Code requirements are illustrated in Figure 3.1. Single storey buildings less than 4.3 m (14' 1") wide can also be anchored by using 12.7 mm (1/2") diameter corrosion resistant rods or cables near each building corner.

Sill Plate Anchorage

Sill plates that sit on the foundation wall can be used both to help level the floor system and to transfer floor loads to the foundation walls. Sill plates support joists and headers and must be set and levelled in a full mortar bed. Alternatively, they can be laid directly on the top of a level foundation. Good sealing is most important in this traditionally leaky part of the building. Chapter 13 describes the air tightness requirements of the Code.

The plate must be anchored to the foundation wall with at least 12.7 mm (1/2") diameter anchor bolts spaced no more than 2.4 m (7' 10") apart. The bolts must be embedded no less than 100 mm (4") into the foundation. Refer to Figure 3.1.

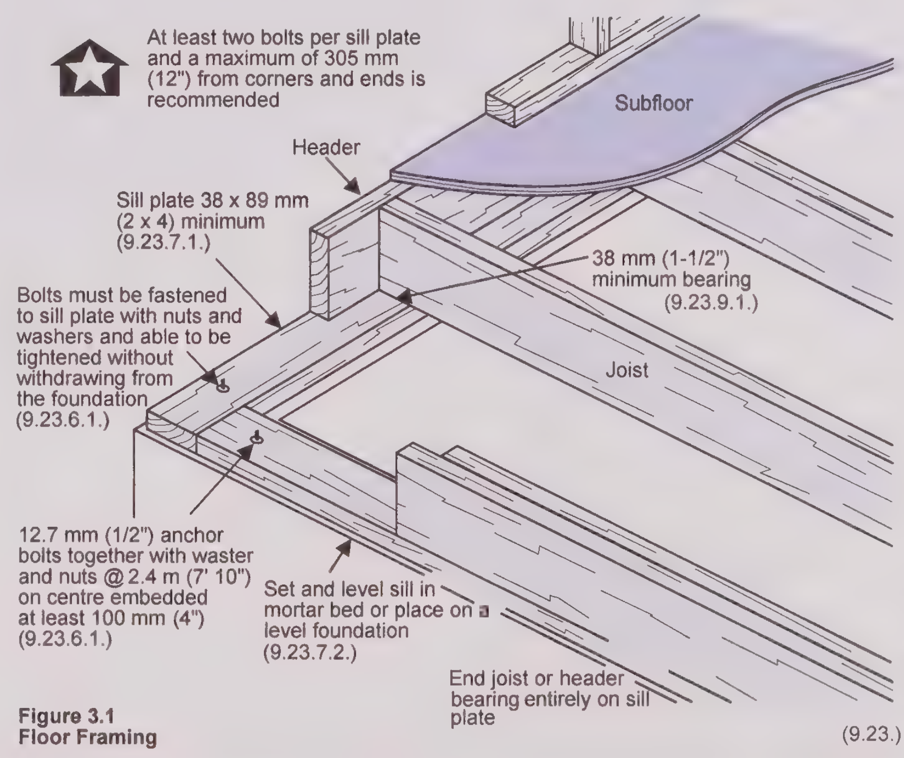


Figure 3.1
Floor Framing

Joist and Beam Embedment

Floor beams and joists can be embedded in the concrete of the foundation wall as a way of anchoring the floor to the building's foundation. Using this system, the ends of the wood members must be treated to prevent decay. Treatment with two coats of a copper naphthenate solution (17%) by weight is recommended. Suppliers of treated lumber products can generally supply the compatible preservative solution. Alternatively, a 12.7 mm (1/2") air space can be provided around the member end as illustrated in Figure 3.2. Wood columns or other wooden elements supported on concrete in contact with the ground must also be protected. Polyethylene or type S roll roofing can be used as shown in Figure 3.3. Alternatively, pressure treated wood can be used.

Care should be taken to ensure that fire separations are maintained where joists and beams are embedded in concrete or masonry walls. The thickness of the fire separation must not be reduced to less than what is required to maintain the required fire resistance rating. Chapter 6 details the fire safety requirements of the Code.

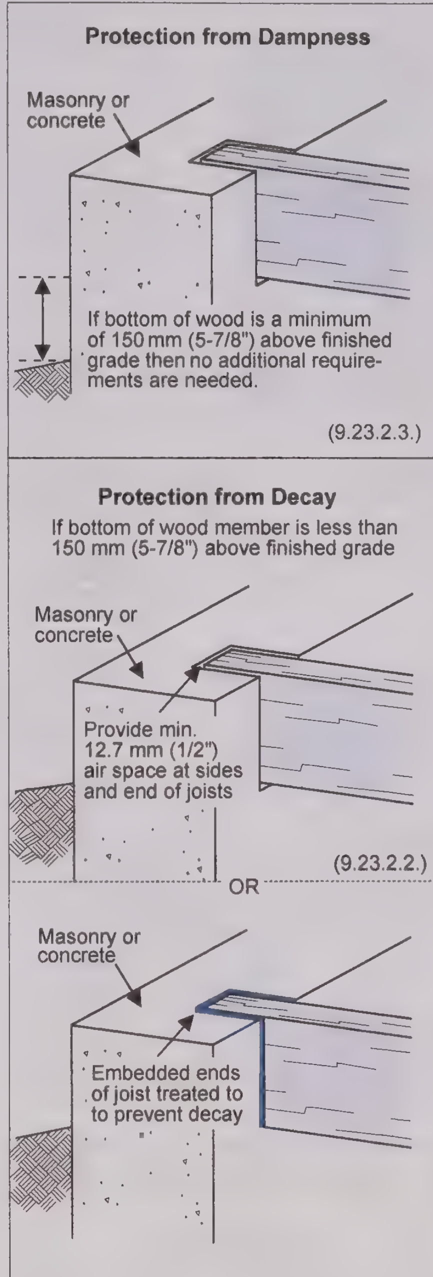


Figure 3.2
Joist and Beam Embedment (9.23.2.2.)

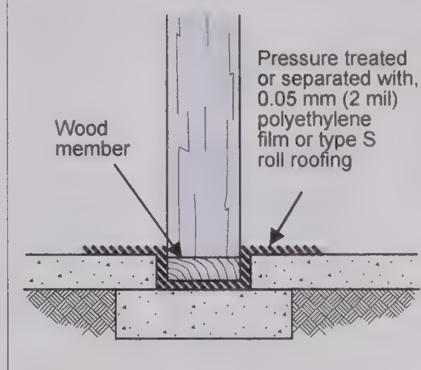


Figure 3.3
Protection From Dampness Below Ground (9.23.2.3.(1))

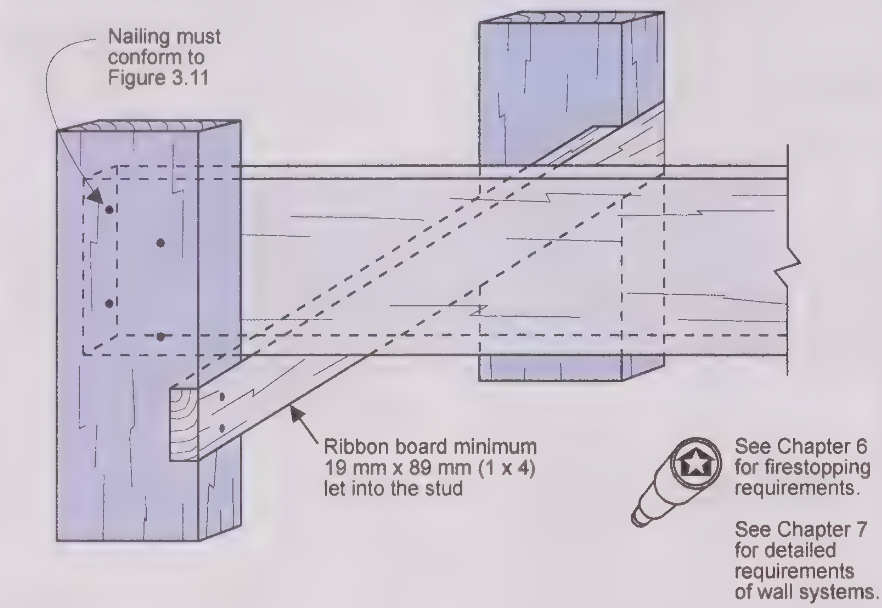


Figure 3.4
Floor Joists Framed into Walls (9.23.9.1.)

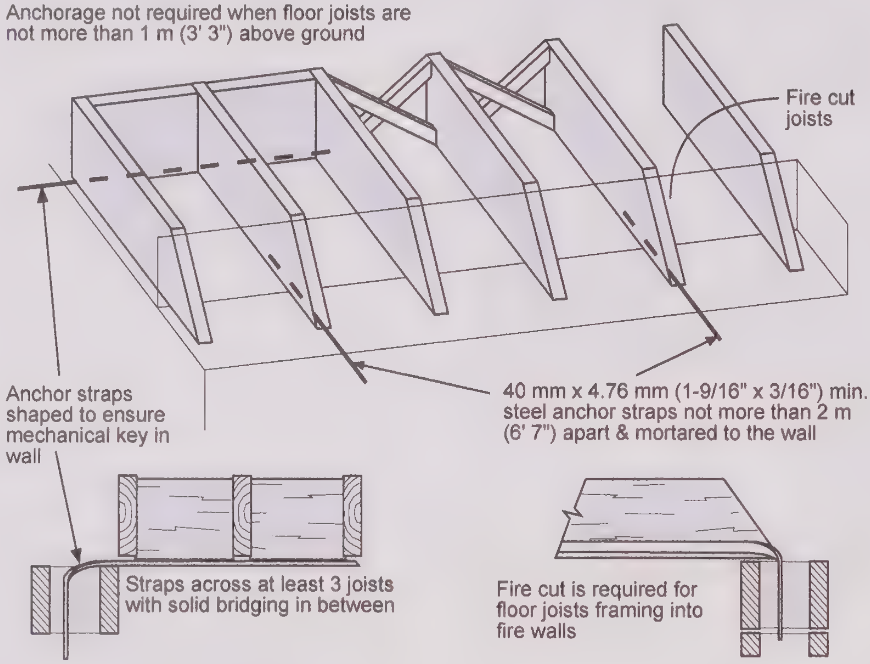


Figure 3.5
Masonry Wall Anchorage (9.20.11.1.)

Floor Joists Framed into Walls

Floor joists framed into walls must bear on a ribbon board which has been let into the wall studding. It is important that adequate bearing be provided and that the ribbon board be mounted into the face of the stud wall to avoid nail pull out. The ribbon board must be no less than 19 mm x 89 mm (1 x 4). Refer to Figure 3.4.

Anchorage of Floor Assemblies to Above-Grade Masonry

Floor systems that provide lateral support for above-grade masonry walls where the floor system is more than 1 m (3' 3") above ground must be anchored to the walls at an interval of not more than 2 m (6' 7") with corrosion-resistant anchors 40 mm (1-9/16") by 4.76 mm (3/16") thick or equivalent. The anchors must be shaped to bond with the masonry and must be securely fastened to the floor system.

Where floor joists extend parallel to the laterally supported masonry wall, anchors must extend across at least 3 floor joists. Figure 3.5 illustrates one approach to floor/masonry wall anchorage.

BEAMS AND JOISTS

BUILDING CODE REFERENCES

DIVISION B

9.23.4.1.	Application
9.23.4.2	Spans for Joists, Rafters and Beams
9.23.4.3.	Steel Beams
9.23.4.4.	Concrete Topping
9.23.5.1.	Holes Drilled in Framing Members
9.23.5.2.	Notching of Framing Members
9.23.5.3.	Wall Studs
9.23.8.2.	Priming of Steel Beams

Beams and joists are the primary structural components of floor systems in small buildings. Beams support floor joists and sometimes roof loads from the structure above. Typically, beams transfer loads to columns and/or to the foundation walls. The Code provides maximum span tables for beams and joists. A worked example can be found at the end of this chapter that illustrates how to use these span tables.

Beam Selection

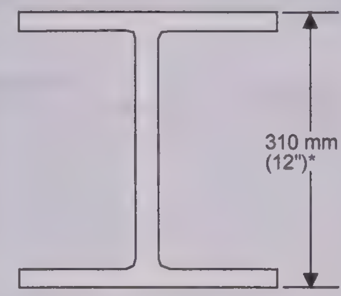
The Code provides selection tables for wood and steel beams. Figures 3.6 to 3.9 are excerpts from the selection tables. Part 4 of the Building Code must be used in all instances not explicitly provided for in these tables.

The steel beam selection Table 9.23.4.3. found in the Code can be used for one and two storey dwelling units. The steel strength must be at least equal to Grade 350W steel as described in standard CAN/CSA - G-40.21 "Structural Quality Steel". In addition, the steel beam must be laterally supported as shown in Figure 3.17. Exterior steel beams susceptible to corrosion must be shop primed with rust inhibitive paint.

A glue-laminated floor beam selection table is provided in the Housing Code that follows the Guide portion of this publication. This table can only be used for beams supporting no more than three floors.

Span tables for built-up wood beams can also be found in the Housing Code. These tables are limited to beams which support no more than three floors and to beams no larger than 5 plys of 38 mm x 286 mm (5 plys of 2 x 12) lumber. Beams of lumber species other than commercially available Canadian species listed in the tables must be designed to Part 4.

Steel Beam Designations



W310 X 60 (metric designation)

nominal depth*	nominal mass
= 310 mm or 12"	= 60 kg/m or 40 lbs/ft

W12 X 40 (imperial designation)

*In some cases the nominal depth may be significantly different from the actual depth. Consult your supplier for exact dimensions or the Canadian Steel Institute Design Handbook.

Maximum Spans for Built-up Floor Beams Supporting not more than One Floor in Houses

Commercial Designation	Grade	Supported Joist Length[(3)(4)] m (ft-in)	Maximum Spacing								
			Size of Built-Up Beam, mm (in)								
			3-38 x 184 (2 x 8)	4-38 x 184 (2 x 8)	5-38 x 184 (2 x 8)	3-38 x 235 (2 x 10)	4-38 x 235 (2 x 10)	5-38 x 235 (2 x 10)	3-38 x 286 (2 x 12)	4-38 x 286 (2 x 12)	5-38 x 286 (2 x 12)
			Maximum Spans, mm (ft-in)[(5)(6)]								
Spruce-Pine-Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4 (7' 10")	3.17 (10' 4")	3.49 (11' 5")	3.76 (12' 4")	4.05 (13' 3")	4.46 (14' 7")	4.81 (15' 9")	4.93 (16' 2")	5.42 (17' 9")	5.73 (18' 9")
		3 (9' 10")	2.95 (9' 8")	3.24 (10' 7")	3.49 (11' 5")	3.76 (12' 4")	4.14 (13' 6")	4.46 (14' 7")	4.58 (15' 0")	5.04 (16' 6")	5.42 (17' 9")
		3.6 (11' 10")	2.77 (9' 1")	3.05 (10' 0")	3.29 (10' 9")	3.54 (11' 7")	3.90 (12' 9")	4.20 (13' 9")	4.31 (14' 1")	4.74 (15' 6")	5.11 (16' 9")
		4.2 (13' 9")	2.63 (8' 7")	2.90 (9' 6")	3.12 (10' 2")	3.36 (11' 0")	3.70 (12' 1")	3.99 (13' 1")	4.09 (13' 5")	4.51 (14' 9")	4.85 (15' 10")
		4.8 (15' 9")	2.52 (8' 3")	2.77 (9' 1")	2.99 (9' 9")	3.22 (10' 6")	3.54 (11' 7")	3.81 (12' 5")	3.82 (12' 6")	4.31 (14' 1")	4.64 (15' 2")
		5.4 (17' 9")	2.42 (7' 11")	2.67 (8' 9")	2.87 (9' 4")	3.09 (10' 1")	3.41 (11' 2")	3.67 (12' 0")	3.60 (11' 9")	4.14 (13' 6")	4.46 (14' 7")
		6 (19' 8")	2.34 (7' 8")	2.57 (8' 5")	2.77 (9' 1")	2.95 (9' 8")	3.29 (10' 9")	3.54 (11' 7")	3.32 (10' 10")	3.95 (12' 11")	4.31 (14' 1")
	No. 1 and 2	2.4 (7' 10")	3.07 (10' 0")	3.38 (11' 1")	3.64 (11' 11")	3.92 (12' 10")	4.32 (14' 2")	4.65 (15' 3")	4.57 (14' 11")	5.25 (17' 2")	5.59 (18' 4")
		3 (9' 10")	2.85 (9' 4)	3.14 (10' 3")	3.38 (11' 1")	3.52 (11' 6")	4.01 (13' 1")	4.32 (14' 2")	4.09 (13' 5")	4.72 (15' 5")	5.25 (17' 2")
		3.6 (11' 10")	2.63 (8' 7")	2.95 (9' 8")	3.18 (10' 5")	3.22 (10' 6")	3.71 (12' 2")	4.06 (13' 3")	3.73 (12' 2")	4.31 (14' 1")	4.82 (15' 9")
		4.2 (13' 9")	2.44 (8' 0")	2.80 (9' 2")	3.02 (9' 10")	2.98 (9'9")	3.44 (11' 3")	3.84 (12' 7")	3.46 (11' 4")	3.99 (13' 1")	4.46 (14' 7")
		4.8 (15' 9")	2.28 (7' 5")	2.63 (8' 7")	2.89 (9' 5")	2.79 (9' 1")	3.22 (10' 6")	3.60 (11' 9")	3.23 (10' 7")	3.73 (12' 2")	4.17 (13' 8")
		5.4 (17' 9")	2.15 (7' 0")	2.48 (8' 1")	2.77 (9' 1")	2.63 (8'7")	3.03 (9'11")	3.39 (11' 1")	3.05 (10' 0")	3.52 (11' 6")	3.93 (12' 10")
		6 (19' 8")	2.04 (6' 8")	2.35 (7' 8")	2.63 (8' 7")	2.49 (8' 2")	2.88 (9' 5")	3.22 (10' 6")	2.89 (9' 5")	3.34 (10' 11")	3.73 (12' 2")

Notes
(1) Beam spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floors does not exceed that specified for residential areas as described in Table 4.1.5.3.
(2) When the floors have a concrete topping of not more than 51 mm (2") the spans must be multiplied by 0.8.
(3) Supported length means half the sum of the joists spans on both sides of the beam.
(4) Straight interpolation may be used for other supported lengths.
(5) Spans are clear spans between supports. For total span, add two bearing lengths.
(6) 3-ply beams with supported lengths greater than 4.2 m (13' 9") require minimum bearing length of 114 mm (4-1/2"). All other beams require minimum bearing of 76 mm (3").

See the Canadian Wood Council Span Book for more information. All imperial values are based on hard conversion of metric span values which are based on 305 mm (12"), 406 mm (16"), and 610 mm (24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Figure 3.6
Built-up Floor Beam Spans - One Floor Supported

Table A-8
(9.23.4.2.)

Maximum Spans for Built-up Floor Beams Supporting not more than Two Floors in Houses (m (ft-in))

Commercial Designation	Grade	Supported Joist Length [3] [4] m (ft-in)	Maximum Span [5] [6]								
			Size of Built-Up Beam, mm (in)								
			3-38 x 184 (2 x 8)	4-38 x 184 (2 x 8)	5-38 x 184 (2 x 8)	3-38 x 235 (2 x 10)	4-38 x 235 (2 x 10)	5-38 x 235 (2 x 10)	3-38 x 286 (2 x 12)	4-38 x 286 (2 x 12)	5-38 x 286 (2 x 12)
			m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)
Spruce-Pine-Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4 (7' 10")	2.64 (8' 7")	2.91 (9' 6")	3.13 (10' 3")	3.37 (11' 0")	3.71 (12' 2")	4.00 (13' 1")	4.05 (13' 3")	4.52 (14' 9")	4.87 (15' 11")
		3 (9' 10")	2.45 (8' 0")	2.70 (8' 10")	2.91 (9' 6")	3.12 (10' 2")	3.45 (11' 3")	3.71 (12' 2")	3.62 (11' 10")	4.18 (13' 8")	4.52 (14' 9")
		3.6 (11' 10")	2.31 (7' 6")	2.54 (8' 3")	2.73 (8' 11")	2.79 (9' 1")	3.24 (10' 7")	3.49 (11' 5")	3.14 (10' 3")	3.82 (12' 6")	4.25 (13' 11")
		4.2 (13' 9")	2.07 (6' 9")	2.41 (7' 10")	2.60 (8' 6")	2.46 (8' 0")	3.04 (9' 11")	3.32 (10' 10")	2.77 (9' 1")	3.50 (11' 5")	3.95 (12' 11")
		4.8 (15' 9")	1.85 (6' 0")	2.31 (7' 6")	2.48 (8' 1")	2.21 (7' 3")	2.79 (9' 1")	3.17 (10' 4")	2.50 (8' 2")	3.14 (10' 3")	3.69 (12' 1")
		5.4 (17' 9")	1.69 (5' 6")	2.13 (6' 11")	2.39 (7' 10")	2.02 (6' 7")	2.53 (8' 3")	3.00 (9' 10")	2.28 (7' 5")	2.85 (9' 4")	3.42 (11' 2")
		6 (19' 8")	1.56 (5' 1")	1.95 (6' 4")	2.31 (7' 6")	1.86 (6' 1")	2.32 (7' 7")	2.79 (9' 1")	2.11 (6' 11")	2.62 (8' 7")	3.14 (10' 3")
	No. 1 and 2	2.4 (7' 10")	2.41 (7' 10")	2.79 (9' 1")	3.03 (9' 11")	2.95 (9' 8")	3.41 (11' 2")	3.81 (12' 5")	3.42 (11' 2")	3.95 (12' 11")	4.42 (14' 6")
		3 (9' 10")	2.16 (7' 1")	2.49 (8' 2")	2.79 (9' 1")	2.64 (8' 7")	3.05 (10' 0")	3.41 (11' 2")	3.06 (10' 0")	3.53 (11' 6")	3.95 (12' 11")
		3.6 (11' 10")	1.97 (6' 5")	2.27 (7' 5")	2.54 (8' 3")	2.41 (7' 10")	2.78 (9' 1")	3.11 (10' 2")	2.79 (9' 1")	3.23 (10' 7")	3.61 (11' 10")
		4.2 (13' 9")	1.82 (5' 11")	2.11 (6' 11")	2.35 (7' 8")	2.23 (7' 3")	2.57 (8' 5")	2.88 (9' 5")	2.59 (8' 5")	2.99 (9' 9")	3.34 (10' 11")
		4.8 (15' 9")	1.71 (5' 7")	1.97 (6' 5")	2.20 (7' 2")	2.09 (6' 10")	2.41 (7' 10")	2.69 (8' 9")	2.42 (7' 11")	2.79 (9' 1")	3.12 (10' 2")
		5.4 (17' 9")	1.61 (5' 3")	1.86 (6' 1")	2.08 (6' 9")	1.97 (6' 5")	2.27 (7' 5")	2.54 (8' 3")	2.28 (7' 5")	2.63 (8' 7")	2.95 (9' 8")
		6 (19' 8")	1.53 (5' 0")	1.76 (5' 9")	1.97 (6' 5")	1.86 (6' 1")	2.15 (7' 0")	2.41 (7' 10")	2.11 (6' 11")	2.50 (8' 2")	2.79 (9' 1")

Notes

(1) Beam spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floors does not exceed that specified for residential areas as described in Table 4.1.5.3.
(2) When the floors have a concrete topping of not more than 51 mm (2") the spans must be multiplied by 0.8.
(3) Supported length means half the sum of the joists spans on both sides of the beam.
(4) Straight interpolation may be used for other supported lengths.
(5) Spans are clear spans between supports. For total span, add two bearing lengths.
(6) 3-ply beams with supported lengths greater than 4.2 m (13' 9") require minimum bearing length of 114 mm (4-1/2"). All other beams require minimum bearing of 76 mm (3").

See the Canadian Wood Council Span Book for more information. All imperial values are based on hard conversion of metric span values which are based on 305 mm (12"), 406 mm (16"), and 610 mm (24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Figure 3.7
Built-up Floor Beam Spans - Two Floors Supported

Table A-9
(9.23.4.2.)

Maximum Spans for Built-up Floor Beams Supporting not more than Three Floors in Houses (m (ft-in))

Commercial Designation	Grade	Supported Joist Length (3) (4) m (ft-in)	Maximum Span (5) (6) Size of Built-Up Beam, mm (in)								
			3-38 x 184 (2 x 8) m (ft-in)	4-38 x 184 (2 x 8) m (ft-in)	5-38 x 184 (2 x 8) m (ft-in)	3-38 x 235 (2 x 10) m (ft-in)	4-38 x 235 (2 x 10) m (ft-in)	5-38 x 235 (2 x 10) m (ft-in)	3-38 x 286 (2 x 12) m (ft-in)	4-38 x 286 (2 x 12) m (ft-in)	5-38 x 286 (2 x 12) m (ft-in)
Spruce-Pine-Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4 (7' 10")	2.35 (7' 8")	2.58 (8' 5")	2.78 (9' 1")	2.89 (9' 5")	3.30 (10' 9")	3.55 (11' 7")	3.24 (10' 7")	3.89 (12' 9")	4.33 (14' 2")
		3 (9' 10")	2.02 (6' 7")	2.40 (7' 10")	2.58 (8' 5")	2.40 (7' 10")	3.00 (9' 10")	3.30 (10' 9")	2.71 (8' 10")	3.42 (11' 2")	3.89 (12' 9")
		3.6 (11' 10")	1.74 (5' 8")	2.20 (7' 2")	2.43 (7' 11")	2.08 (6' 9")	2.62 (8' 7")	3.06 (10' 0")	2.35 (7' 8")	2.95 (9' 8")	3.54 (11' 7")
		4.2 (13' 9")	1.55 (5' 1")	1.94 (6' 4")	2.31 (7' 6")	1.85 (6' 0")	2.31 (7' 6")	2.77 (9' 1")	2.10 (6' 10")	2.61 (8' 6")	3.12 (10' 2")
		4.8 (15' 9")	1.40 (4' 7")	1.74 (5' 8")	2.09 (6' 10")	1.68 (5' 6")	2.08 (6' 9")	2.48 (8' 1")	1.91 (6' 3")	2.35 (7' 8")	2.80 (9' 2")
		5.4 (17' 9")	1.28 (4' 2")	1.59 (5' 2")	1.90 (6' 2")	1.54 (5' 0")	1.90 (6' 2")	2.26 (7' 4")	1.76 (5' 9")	2.16 (7' 1")	2.55 (8' 4")
		6 (19' 8")	1.19 (3' 10")	1.47 (4' 9")	1.74 (5' 8")	1.44 (4' 8")	1.76 (5' 9")	2.08 (6' 9")	1.64 (5' 4")	2.00 (6' 6")	2.35 (7' 8")
	No. 1 and 2	2.4 (7' 10")	2.01 (6' 7")	2.32 (7' 7")	2.60 (8' 6")	2.46 (8' 0")	2.84 (9' 3")	3.17 (10' 4")	2.85 (9' 4")	3.29 (10' 9")	3.68 (12' 0")
		3 (9' 10")	1.80 (5' 10")	2.08 (6' 9")	2.32 (7' 7")	2.20 (7' 2")	2.54 (8' 3")	2.84 (9' 3")	2.55 (8' 4")	2.95 (9' 8")	3.29 (10' 9")
		3.6 (11' 10")	1.64 (5' 4")	1.90 (6' 2")	2.12 (6' 11")	2.01 (6' 7")	2.32 (7' 7")	2.59 (8' 5")	2.33 (7' 7")	2.69 (8' 9")	3.01 (9' 10")
		4.2 (13' 9")	1.52 (4' 11")	1.75 (5' 8")	2.96 (9' 8")	1.85 (6' 0")	2.15 (7' 0")	2.40 (7' 10")	2.10 (6' 10")	2.49 (8' 2")	2.78 (9' 1")
		4.8 (15' 9")	1.40 (4' 7")	1.64 (5' 4")	1.84 (6' 0")	1.68 (5' 6")	2.01 (6' 7")	2.24 (7' 4")	1.91 (6' 3")	2.33 (7' 7")	2.60 (8' 6")
		5.4 (17' 9")	1.28 (4' 2")	1.55 (5' 1")	1.73 (5' 8")	1.54 (5' 0")	1.89 (6' 2")	2.12 (6' 11")	1.76 (5' 9")	2.16 (7' 1")	2.46 (8' 0")
		6 (19' 8")	1.19 (3' 10")	1.47 (4' 9")	1.64 (5' 4")	1.44 (4' 8")	1.76 (5' 9")	2.01 (6' 7")	1.64 (5' 4")	2.00 (6' 6")	2.33 (7' 7")

Notes
(1) Beam spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floors does not exceed that specified for residential areas as described in Table 4.1.5.3.
(2) When the floors have a concrete topping of not more than 51 mm (2") the spans must be multiplied by 0.8.
(3) Supported length means half the sum of the joists spans on both sides of the beam.
(4) Straight interpolation may be used for other supported lengths.
(5) Spans are clear spans between supports. For total span, add two bearing lengths.
(6) 3-ply beams with supported lengths greater than 4.2 m (13' 9") require minimum bearing length of 152 mm (6"). All other beams require minimum bearing of 114 mm (4-1/2").

See the Canadian Wood Council Span Book for more information. All imperial values are based on hard conversion of metric span values which are based on 305 mm (12"), 406 mm (16"), and 610 mm (24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Figure 3.8
Built-up Floor Beam Spans - Three Floors Supported

Table A-10
(9.23.4.2.)

Maximum Spans for Steel Beams Supporting Floors in Dwelling Units (m (ft-in))

Storey(s) Supported	Supported Joist Length [1] m (ft-in)	Steel Beam Section Metric Designation (mm x kg/m) [2]								
		W150 x 22	W200 x 21	W200 x 27	W200 x 31	W250 x 24	W250 x 33	W250 x 39	W310 x 31	W310 x 39
		m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)	m (ft-in)
One	2.4 (7' 10")	5.50 (18' 0")	6.50 (21' 3")	7.30 (23' 11")	7.80 (25' 7")	8.10 (26' 6")	9.20 (30' 2")	10.0 (32' 9")	10.4 (34' 1")	11.4 (37' 4")
	3 (9' 10")	5.20 (17' 0")	6.20 (20' 4")	6.90 (22' 7")	7.40 (24' 3")	7.60 (24' 11")	8.70 (28' 6")	9.40 (30' 10")	9.80 (32' 1")	10.7 (35' 1")
	3.6 (11' 10")	4.90 (16' 0")	5.90 (19' 4")	6.60 (21' 7")	7.10 (23' 3")	7.30 (23' 11")	8.30 (27' 2")	9.00 (29' 6")	9.40 (30' 10")	10.2 (33' 5")
	4.2 (13' 9")	4.80 (15' 8")	5.70 (18' 8")	6.30 (20' 8")	6.80 (22' 3")	7.00 (22' 11")	8.00 (26' 2")	8.60 (28' 2")	8.90 (29' 2")	9.80 (32' 1")
	4.8 (15' 9")	4.60 (15' 1")	5.40 (17' 8")	6.10 (20' 0")	6.60 (21' 7")	6.60 (21' 7")	7.70 (25' 3")	8.40 (27' 6")	8.40 (27' 6")	9.50 (31' 2")
	5.4 (17' 9")	4.50 (14' 9")	5.10 (16' 8")	5.90 (19' 4")	6.40 (20' 11")	6.20 (20' 4")	7.50 (24' 7")	8.10 (26' 2")	8.00 (26' 6")	9.20 (30' 2")
	6 (19' 8")	4.30 (14' 1")	4.90 (16' 0")	5.80 (19' 0")	6.20 (20' 4")	5.90 (19' 4")	7.30 (23' 11")	7.90 (25' 11")	7.60 (24' 11")	9.00 (29' 6")
Two	2.4 (7' 10")	4.90 (16' 0")	5.60 (18' 4")	6.40 (20' 11")	6.90 (22' 7")	6.80 (22' 3")	8.20 (26' 10")	8.80 (28' 10")	8.70 (28' 6")	10.0 (32' 9")
	3 (9' 10")	4.40 (14' 5")	5.10 (16' 8")	6.10 (20' 0")	6.50 (21' 3")	6.10 (20' 0")	7.70 (25' 3")	7.80 (27' 2")	8.30 (25' 7")	9.30 (30' 6")
	3.6 (11' 10")	4.10 (13' 5")	4.60 (15' 1")	5.60 (18' 4")	6.20 (20' 4")	5.60 (18' 4")	7.00 (22' 11")	7.80 (25' 7")	7.20 (23' 7")	8.50 (27' 10")
	4.2 (13' 9")	3.80 (12' 5")	4.30 (14' 1")	5.30 (17' 4")	5.80 (19' 0")	5.20 (17' 0")	6.50 (21' 3")	7.20 (23' 7")	6.70 (21' 11")	7.90 (25' 11")
	4.8 (15' 9")	3.50 (11' 5")	4.10 (13' 5")	4.90 (16' 0")	5.40 (17' 8")	4.90 (16' 0")	6.10 (20' 0")	6.80 (22' 3")	6.20 (20' 4")	7.40 (24' 3")
	5.4 (17' 9")	3.40 (11' 1")	3.80 (12' 5")	4.70 (15' 5")	5.10 (16' 8")	4.60 (15' 1")	5.80 (19' 0")	6.40 (20' 11")	5.90 (19' 4")	7.00 (22' 11")
	6 (19' 8")	3.20 (10' 5")	3.70 (12' 1")	4.40 (14' 5")	4.90 (16' 0")	4.40 (14' 5")	5.50 (18' 0")	6.10 (20' 0")	5.60 (18' 4")	6.70 (21' 11")

Notes
(1) Supported joist length means 1/2 the sum of the joist spans on both sides of the beam.
(2) In some cases the nominal depth may be significantly different from the actual depth. Consult your supplier for exact dimensions or the Canadian Steel Institute Design Handbook.
(3) Spans are clear spans between supports. For total length, add two bearing lengths.
(4) These spans apply to steel beams with laterally supported top flanges for floors. For roofs and floors please see other tables in the Building Code.

See the Canadian Wood Council Span Book for more information. All imperial values are based on hard conversion of metric span values which are based on 305 mm (12"), 406 mm (16"), and 610 mm (24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Figure 3.9
Maximum Spans for Steel Beams - Supporting One or Two Storeys (9.23.4.3.)

Joist Selection

Joist span tables are provided in the Housing Code. A floor joist selection table for Spruce-Pine-Fir species joists, No. 1 and No. 2 Grade is presented in Figure 3.10. Note that all limitations from the Housing Code's joist selection tables apply equally to this table.

Three alternative load redistribution methods are available in the selection tables. The Code recognizes that strapping, bridging or a combination of the two can strengthen the load carrying capacity of a floor system.

Further strengthening can result if the subfloor is glued and/or screwed to the top of the floor joists. The subfloor and joists act together to form an integral T-beam which can often eliminate or significantly reduce excessive bounce or vibration in a floor system. Gluing can also reduce floor creaking and squeaking.

Where a floor is required to support a concrete topping, the spacing of the joists must be reduced accordingly to allow for the loads due to the topping (see the Appendix A of the Code for details). Alternatively, the Building Code Compendium contains a joist span table for special cases such as a 38 to 51 mm concrete topping of minimum 20 MPa compressive strength placed directly on the subfloor. Beam spans established in the tables which support floor joists supporting concrete topping not more than 51 mm (2") thick must be multiplied by 0.8 or a reduced span by design.

Maximum Spans for Floor Joists for Living Quarters and Bedrooms (m (ft-in))

Commercial Designation	Grade	Member Size mm (inches)	Strapping Only (1)			Bridging Only (1)			Strapping and Bridging (1)		
			Joist Spacing			Joist Spacing			Joist Spacing		
			305 mm (12")	406 mm (16")	610 mm (24")	305 mm (12")	406 mm (16")	610 mm (24")	305 mm (12")	406 mm (16")	610 mm (24")
Spruce - Pine - Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	No. 1 and 2	38 x 89 (2 x 4)	1.86 (6' 1")	1.72 (5' 7")	1.58 (5' 2")	1.99 (6' 6")	1.81 (5' 11")	1.58 (5' 2")	1.99 (6' 6")	1.81 (5' 11")	1.58 (5' 2")
		38 x 140 (2 x 6)	2.92 (9' 6")	2.71 (8' 10")	2.49 (8' 2")	3.14 (10' 3")	2.85 (9' 4")	2.49 (8' 2")	3.14 (10' 3")	2.85 (9' 4")	2.49 (8' 2")
		38 x 184 (2 x 8)	3.54 (11' 7")	3.36 (11' 0")	3.20 (10' 5")	3.81 (12' 5")	3.58 (11' 8")	3.27 (10' 8")	3.99 (13' 1")	3.72 (12' 2")	3.27 (10' 8")
		38 x 235 (2 x 10)	4.17 (13' 8")	3.96 (12' 11")	3.77 (12' 4")	4.44 (14' 6")	4.17 (13' 8")	3.92 (12' 10")	4.60 (15' 1")	4.29 (14' 0")	4.00 (13' 1")
		38 x 286 (2 x 12)	4.75 (15' 7")	4.52 (14' 9")	4.30 (14' 1")	5.01 (16' 5")	4.71 (15' 5")	4.42 (14' 6")	5.17 (16' 11")	4.82 (15' 9")	4.49 (14' 8")

Notes
(1) Strapping and Bridging shall conform to Article 9.23.9.4. of the Code.

All imperial values are based on hard conversion of metric span values which are based on 305 mm (12"), 406 mm (16"), and 610 mm (24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Figure 3.10
Floor Joist Spans

(9.23.4.2.(1))

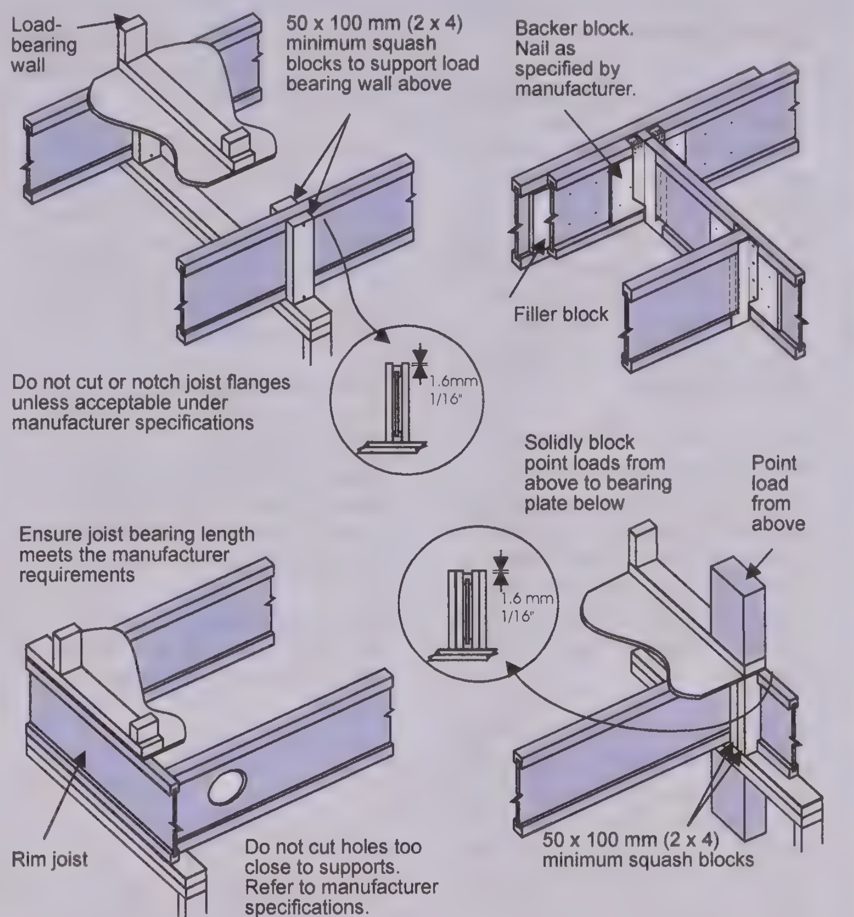
Engineered Floor Systems

Wood "I" or wood truss floor systems are generally proprietary in nature, and must be designed. Information such as support details, truss location, bracing and bridging details, point loads, dead loads, live loads, bearing length, connector hardware and details should all be included on drawings and engineering reports for these floor systems. Other structural components, including foundations, should not be overlooked where these systems are used and may require component design.

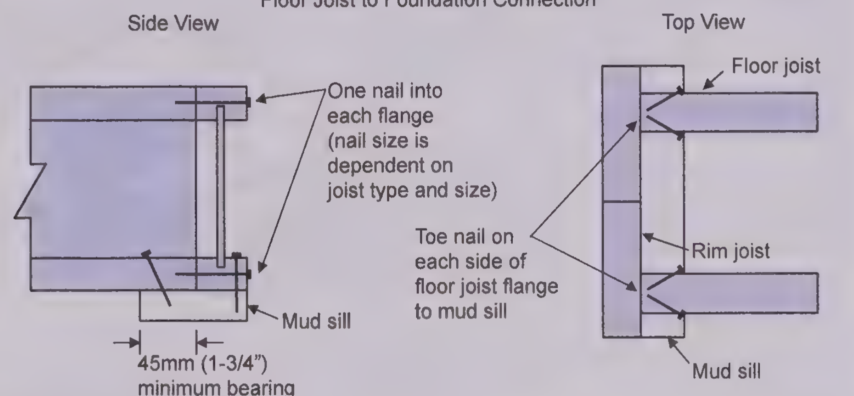
Note: Competent design will be required in all situations where Part 4 applies.

The manufacturers' layout that is required for application for a building permit should be kept on site, for easy reference during inspections.

Details shown may be typical but refer to specific manufacturer requirements for specific applications.



Floor Joist to Foundation Connection



Load Sharing

Load sharing systems can be used in houses to help strengthen and stiffen floors and to help floor joists to aggregately support loads. In general, the system involves tying the floor together to act as a unit. The system restrains the joists from twisting and better utilizes the strength of the joist material.

A basic load sharing system involves the use of solid blocking, bridging, strapping or any combination of these as a means of supporting loaded floor joists by unloaded ones. This basic load sharing system for all floors is a requirement of the Code.

Solid blocking consists of single pieces of boards or blocks set at right angles to the joists and fitted between them. Cross bridging consists of transverse rows of small diagonal braces, set in pairs, which cross each other between joists. To be effective, the rows of bridging should be in straight lines which continuously extend the entire length of the floor.

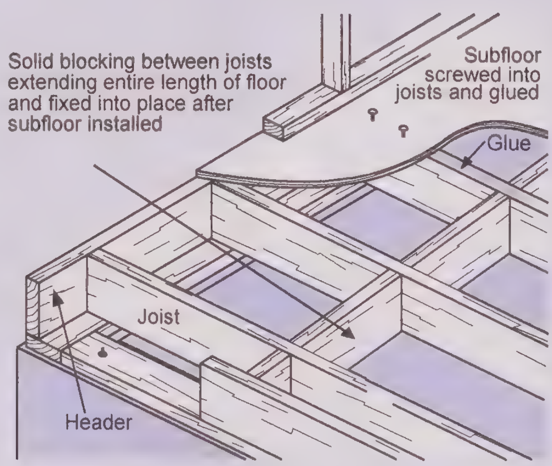
Bridging should not be fixed in place until after the subflooring has been nailed to the joists. When the floor joists have adjusted themselves to the subflooring, the bridging should be fixed into place.

Strapping fastened to the underside of the floor joists can also be used as part of the basic load sharing system. A panel finish such as gypsum board can also be used instead of strapping.

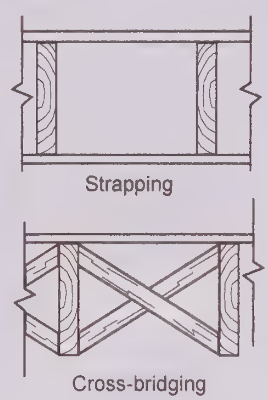
Specific requirements for blocking, bridging and strapping can be found in the Housing Code.

To further enhance the performance of the floor, the subfloor can be coupled to the joists. The subfloor can be glued and screwed to the tops of the joists to form a series of T-beams. This composite structural system provides a degree of rigidity not available in conventionally framed floors.

With careful regard to manufacturer instructions for glue applications, a glued and screwed floor with blocking and/or strapping will reduce or eliminate the problem of the squeaky floor, particularly in those floors where joist spans are at or near the limits of the span tables. Use two rows of bridging or blocking near midspan to stiffen floors.



Note: Canadian Wood Council tables can be used to increase the spans of screwed and glued floors.



FLOOR NAILING

BUILDING CODE REFERENCES

DIVISION B
9.23.3.3. Prevention of Splitting
9.23.3.4. Nailing of Framing
9.23.8.3. Built-up Wood Beams

Floor nailing requirements can be found in Article 9.23.3.4. of the Code. These nailing provisions encompass all nailing requirements for houses. The requirements as they apply to the floor system alone follow.

Nailing of Floor Framing

Figure 3.11 identifies the minimum nail length and number to be used in the framing of floors. Nails must be staggered in the direction of the grain and kept well in from the edges of the member to minimize splitting of the wood.

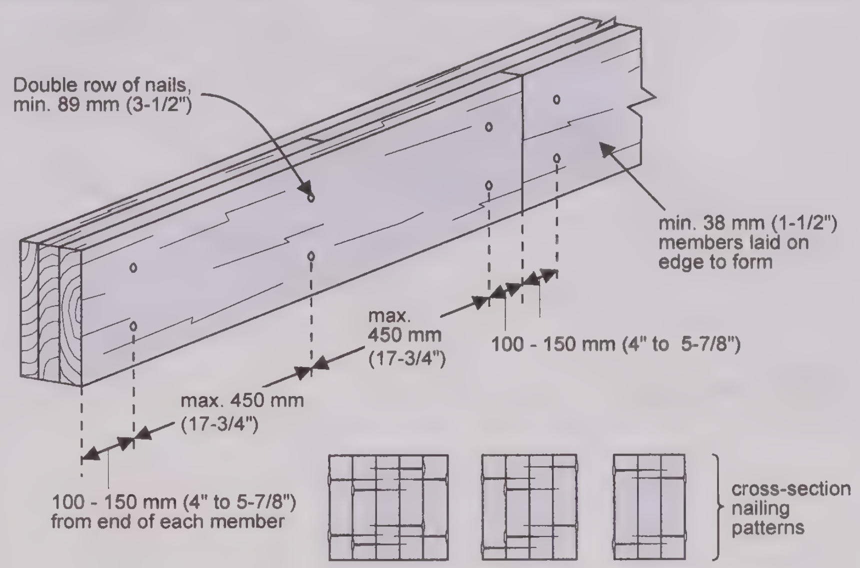
Nailing of Beams

The requirements for the nailing of built-up wood beams are intended to ensure that the built-up wood members act as a single piece of lumber. Three, four, or five individual pieces of lumber that comprise a beam and that have not been suitably tied together will not have the same strength as the equivalent single piece of lumber. Figure 3.12 and 3.13 show the Code requirements for nailing of built-up beams.

Nailing for Framing

Construction Detail	**Minimum Length Nails** mm (inches)	**Minimum Number or Maximum Spacing of Nails**
• Floor joist to plate - toe nail	82 (3-1/4")	2
• Wood or metal strapping to underside of floor joists	57 (2-1/4")	2
• Cross bridging to joists	57 (2-1/4")	2 each end
• Double header or trimmer joists	76 (3")	300 mm (11-3/4") o.c.
• Floor joist to stud (balloon construction)	76 (3")	2
• Ledger strip to wood beam	82 (3-1/4")	2 per joist
• Joist to joist splice	76 (3")	2 at each end
• Tail joist to adjacent header joist (end nailed) around openings	82 (3-1/4") 101 (4")	5 3
• Each header joist to adjacent trimmer joist (end nailed) around openings	82 (3-1/4") 101 (4")	5 3

Figure 3.11
Nailing for Framing (9.23.3.4.)



Note:
As an alternative to nailing, bolt members together with minimum 12.7 mm (1/2") diameter bolts with washers and spaced 1.2 m (3' 11") max. o.c. with end bolts not more than 600 mm (23-5/8") from the ends of the members.

Figure 3.12
Nailing of Built-up Beams (9.23.8.3.)

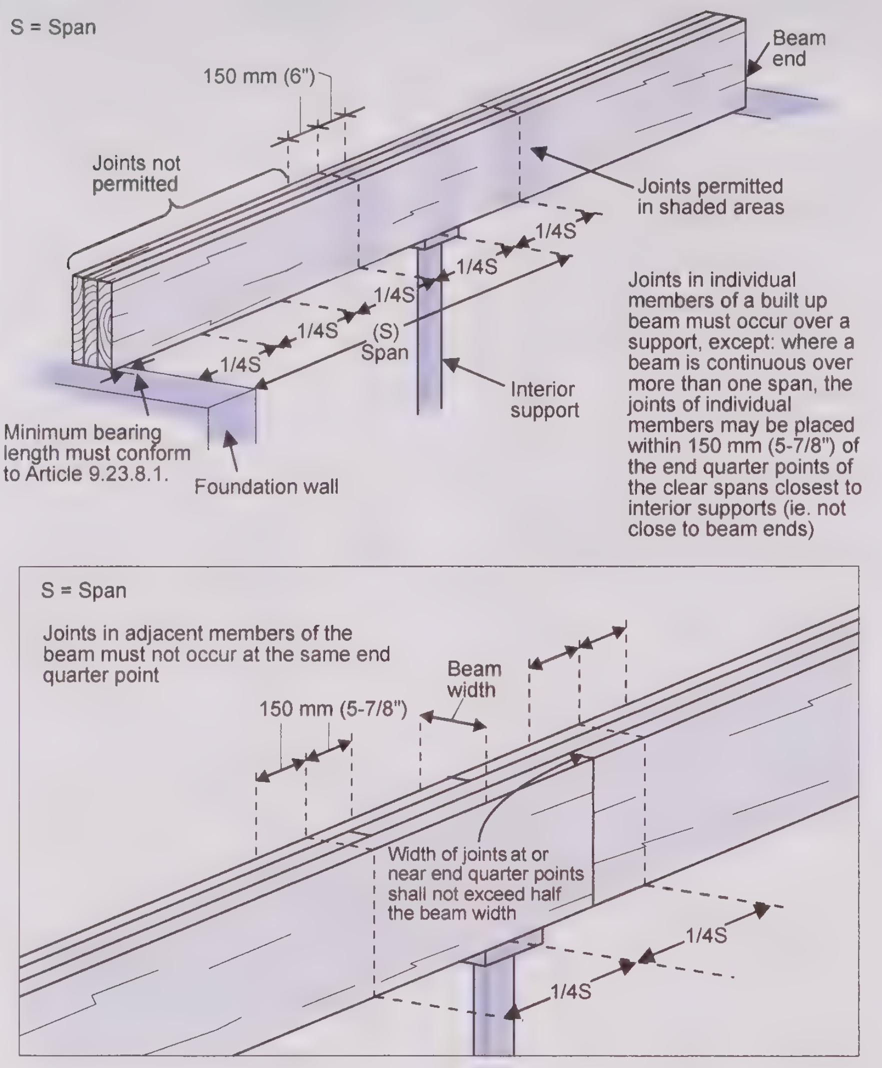


Figure 3.13
Nailing of Built-up Beams (9.23.8.3.)

JOIST AND BEAM SUPPORT

BUILDING CODE REFERENCES

DIVISION B

9.20.8.3.	Bearing of Beams and Joists
9.23.8.1.	Bearing for Beams
9.23.9.1.	End Bearing for Joists
9.23.9.2.	Joists Supported by Beams
9.23.9.3.	Restraint of Joist Bottoms
9.23.9.4.	Strapping and Bridging in Tables A-1 and A-2

Wood, glue-laminated or steel beams used in houses must bear no less than 89 mm (3-1/2") at end supports to avoid the crushing of beam or support material and to adequately transfer the load from the beam to the support. Beams should be level and bear evenly. Refer to Figure 3.14. Further requirements for built-up wood beams are detailed in the notes associated with the span tables in the Code. For example when supporting not more than one floor, 3-ply wood beams supporting lengths greater than 4.2 m (14') require a minimum bearing length of 114 mm (4-1/2") while 4-ply and 5-ply wood beams will only require a minimum bearing length of 76 mm (3").

End bearing for joists can be no less than 38 mm (1-1/2").

Any beam or joist bearing that does not comply with Part 9 must comply with Part 4.

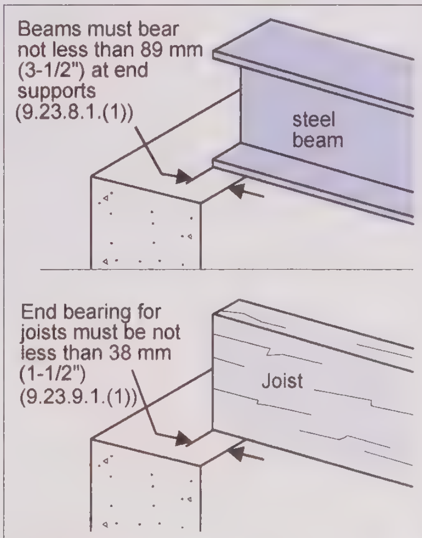


Figure 3.14
Joist and Beam Bearing

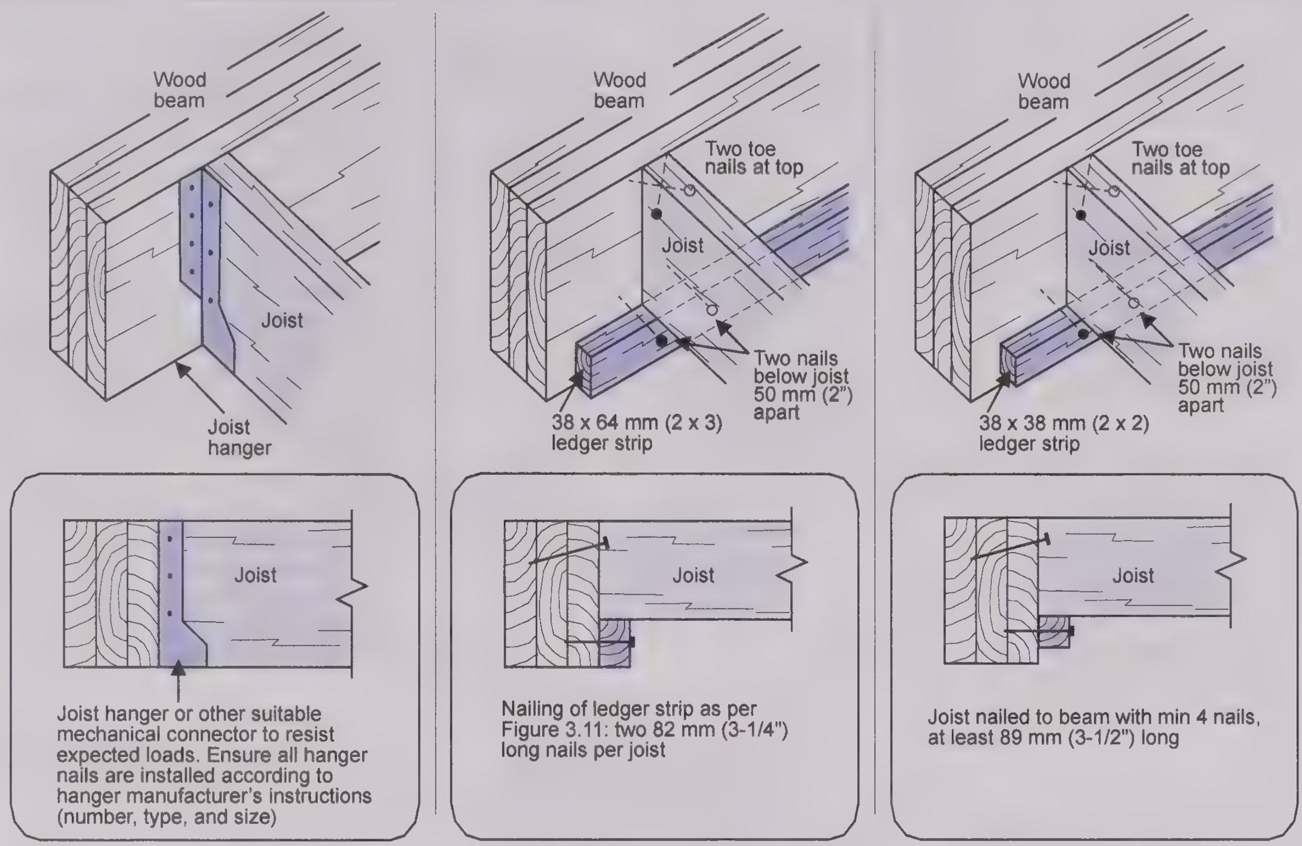


Figure 3.15
Alternatives for Mounting Joists Into the Sides of Wood Beams (9.23.9.2.(2))

Joists Supported by Beams

Joists can bear directly on beams or they can be framed into the beam side. A side-mounted joist framing system allows for increased headroom and an unobstructed ceiling. This framing alternative, however, makes duct layout more difficult since duct chases which would otherwise be present are now obstructed by beams.

Joists can be side mounted to wood beams with joist hangers or they can bear onto ledger strips which are nailed to the beam. Figure 3.15 illustrates the Code requirements for joists that frame into the sides of wood beams. Figure 3.16 also shows the provisions for joists that are mounted onto the sides of steel beams.

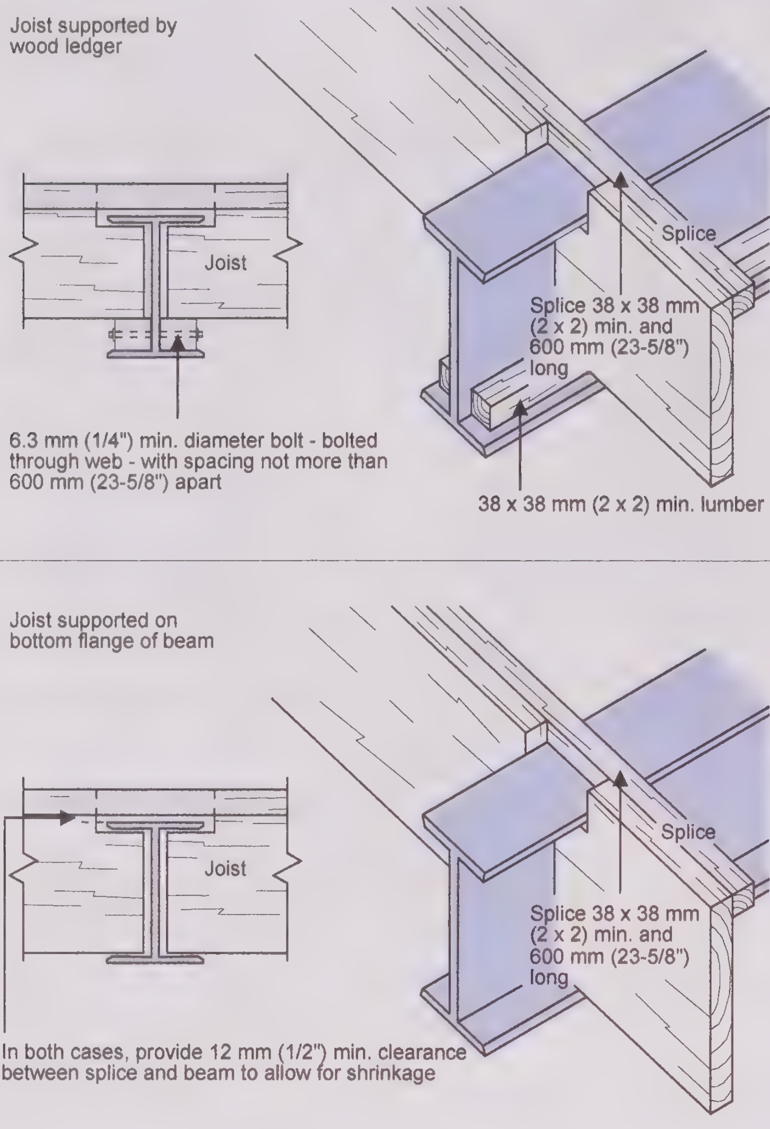
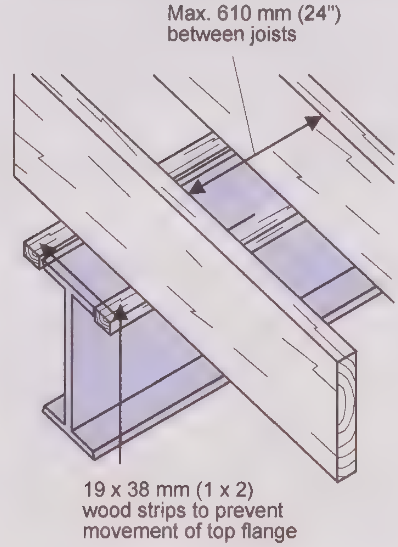


Figure 3.16
Alternatives for Mounting Joists Into the Sides of Steel Beams (9.23.9.2.)

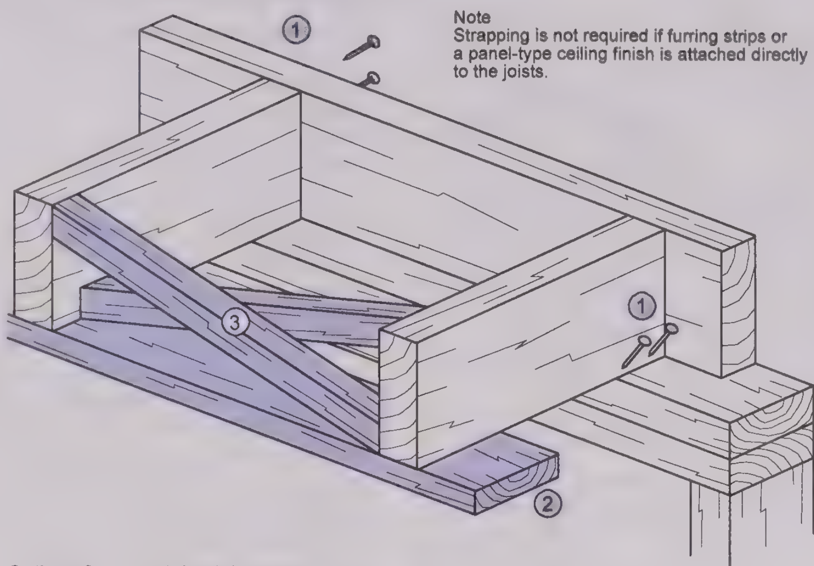
Beam Twisting

When load is applied to beams and joists there is a natural tendency for the member to twist out from under the load. This twisting must be resisted if the beam or joist is to achieve its full strength.

The steel beam selection tables have been developed assuming the steel beams will be supported laterally; that is, a means is provided to resist the twisting of the beam as load is applied. Steel beams are considered laterally supported if load carrying wood joists bear on the top flange of the beam at intervals of 610 mm (24") or less over its entire length and if 19 mm x 38 mm (1 x 2) wood strips in contact with the top flange are nailed on both sides of the beam to the bottom of the joist. Refer to Figure 3.17.



(9.23.4.3.(3))
Figure 3.17
Laterally Supported Steel Beams



Options for restraining joist twisting:
1. end nail to header and toe nail to support OR
2. provide continuous strapping near support AND
3. cross bridging or solid blocking (not shown) near support

Figure 3.18 (9.23.9.3.)
Restraining Joist Twisting at Ends (9.23.9.4.)

Joist Twisting

Floor joists must be restrained from twisting. Toe-nailing their ends to the supports and end-nailing them to header joists is the most common method of restraint. Continuous strapping, blocking or cross-bridging near the supports may also be provided to resist joist twisting.

Bridging, strapping or both must be provided for the full development of the strength of the floor as noted earlier.

Figure 3.18 illustrates approaches to floor stiffening.

Rows of bridging or strapping must not be more than 2.1 m (6' 10") from each support and at intermediate locations so that the distance between rows does not exceed 2.1 m (6' 10"). Bridging and strapping must not be interrupted, but must extend from joist support to joist support.

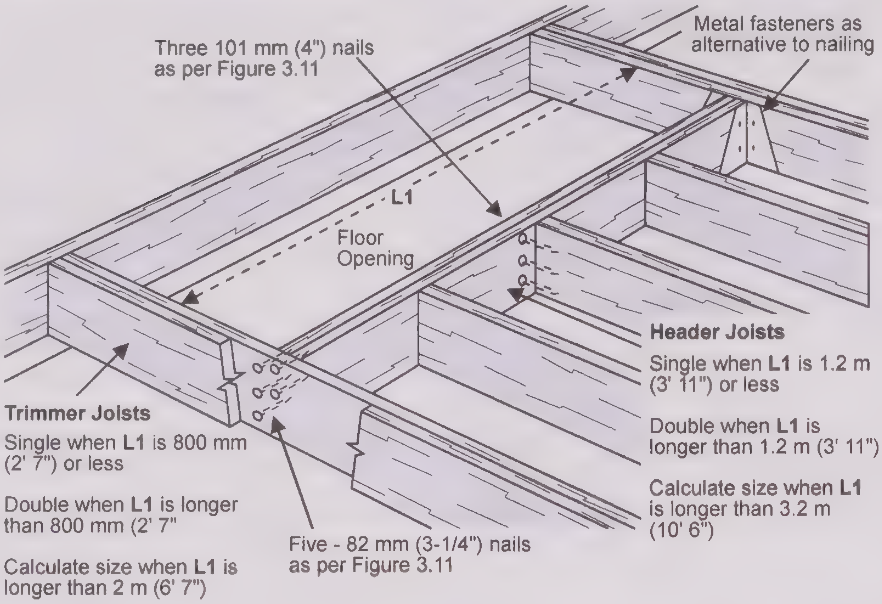


Figure 3.19
Framing Around Floor Openings

(9.23.9.5.)
(9.23.9.6.)
(9.23.9.7.)

OPENINGS IN FLOORS

BUILDING CODE REFERENCES

DIVISION B

9.23.9.5. Header Joists
9.23.9.6. Trimmer Joists
9.23.9.7. Support of Tail and Header Joists

Floor openings must always be reinforced with double headers when the length of the header at the opening exceeds 1.2 m (3' 11"). Double trimmer joists are required when the length of the header at the opening exceeds 800 mm (2' 7"). Headers at the opening greater than 2 m (6' 7") will require the trimmer joists to be designed by calculation (see Part 4 of the Code). Similarly, header joists sizes must be calculated when the header length at the opening exceeds 3.2 m (10' 6"). Refer to Figure 3.19.

SUPPORT OF INTERIOR WALLS

BUILDING CODE REFERENCES

DIVISION B
9.23.9.8. Support of Walls

Loadbearing interior partition walls that carry no floor load and that are at right angles to floor joists must be no more than 900 mm (2' 11") from the joist support, such as a beam or loadbearing wall. If floor loads are present, the support can be no further than 600 mm (23-5/8") from the loadbearing partition. Figure 3.20 illustrates this Code provision.

The support of non-loadbearing walls must be consistent with the Code provisions as illustrated in Figure 3.21.

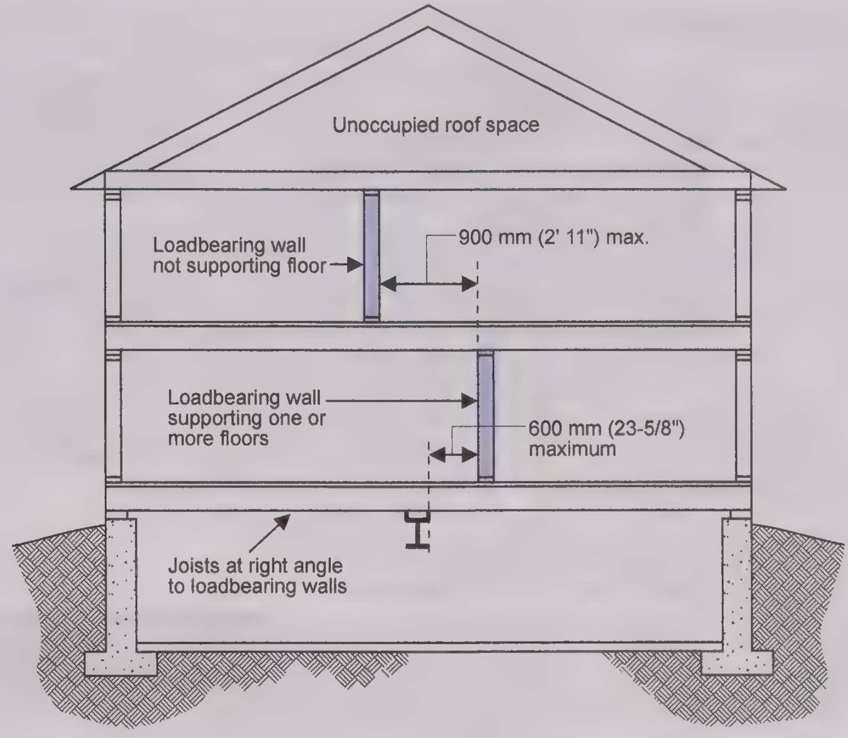


Figure 3.20
Location of Loadbearing Interior Walls (9.23.9.8.(5))

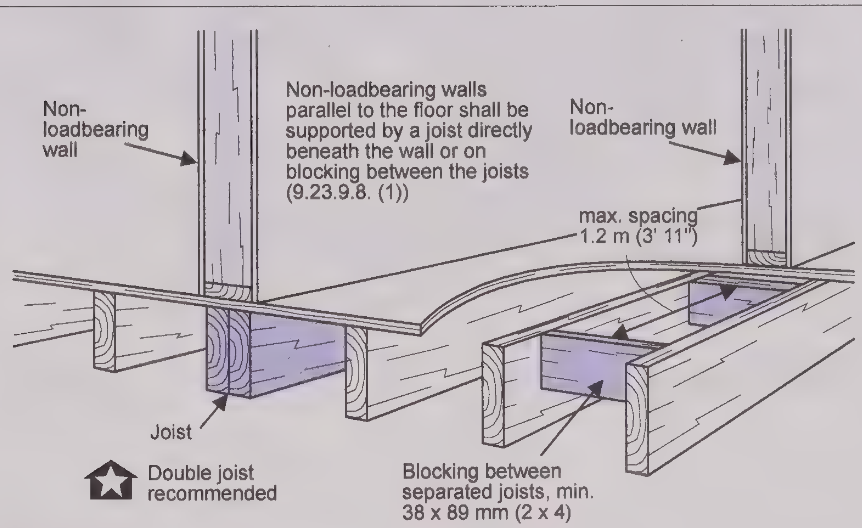
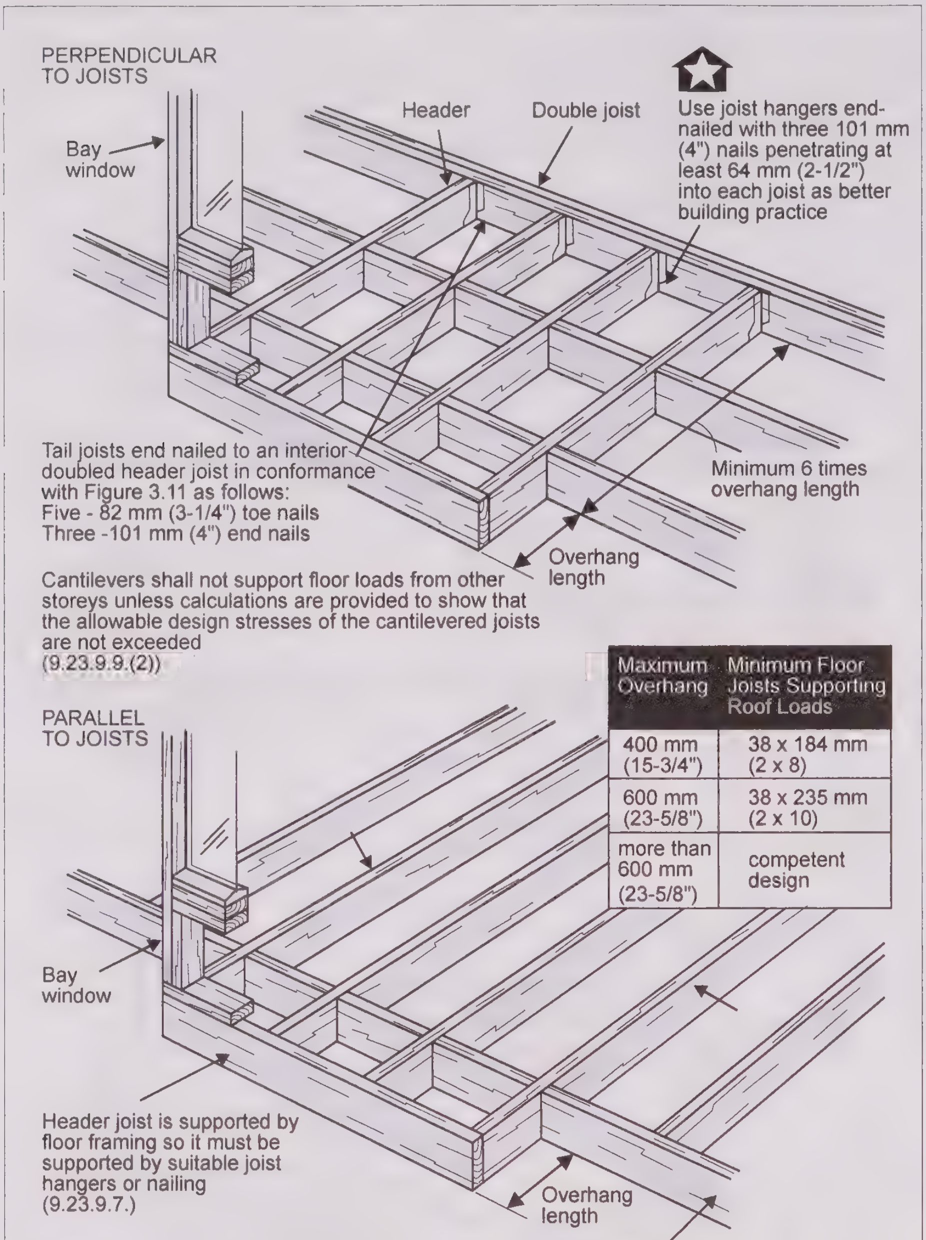


Figure 3.21
Support of Non-Loadbearing Walls (9.23.9.8.)



Maximum Overhang	Minimum Floor Joists Supporting Roof Loads
400 mm (15-3/4")	38 x 184 mm (2 x 8)
600 mm (23-5/8")	38 x 235 mm (2 x 10)
more than 600 mm (23-5/8")	competent design

Figure 3.22
Cantilever Floor Joists (9.23.9.9.)

CANTILEVERS

BUILDING CODE REFERENCES

DIVISION B
9.23.9.7. Support of Tail and Header Joists
9.23.9.9. Cantilevered Floor Joists

Cantilevers are limited to 600 mm (23-5/8") in the Code. Calculations must be provided for all other cases. Figure 3.22 shows the Code requirements as they relate to cantilevers.

SUBFLOORS

BUILDING CODE REFERENCES

DIVISION B

9.23.3.5. Fastening for Sheathing and Subflooring
9.23.14.1. Subflooring Required
9.23.14.2. Material Standards
9.23.14.3. Edge Support
9.23.14.4. Direction of Installation
9.23.14.5. Subfloor Thickness or Rating
9.23.14.6. Annular Grooved Nails
9.23.14.7. Lumber Subflooring

Subflooring is used where finish flooring does not have adequate strength to support the design loads. Subfloor wood panels must conform to a number of standards including:

- CSA 0121-M, "Douglas Fir Plywood",
- CSA 0151, "Canadian Softwood Plywood",
- CSA 0153-M, "Poplar Plywood",
- CAN/CSA-0325.0, "Construction Sheathing", or
- CSA 0437.0, "OSB and Waferboard".

Particleboard subflooring may only be used in factory-built floor systems which are not exposed to weather. This subflooring material must meet a number of water repelling requirements identified in Article 9.23.14.2. of the Building Code.

Thickness, Support and Nailing of Subfloors

Figure 3.23 provides a summary of the subfloor thickness requirements of the Code depending on the subfloor material, the support spacing and the finished floor anticipated.

Subfloors must provide adequate support for ceramic tile to prevent cracking. Refer to Chapter 14 Interior Finishes. Other subfloor support requirements are illustrated in Figure 3.24.

The nailing requirements for subfloors are contained in the general nailing provisions of the Code. These are summarized in Figure 3.25.

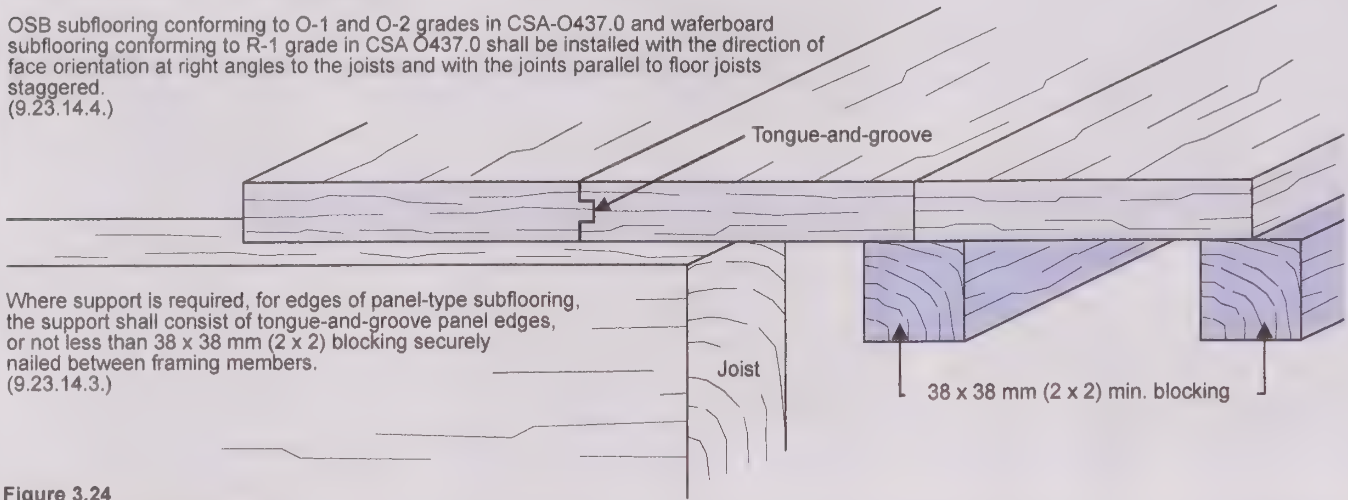
Thickness of Subflooring, mm (in) Depending on Support Spacing and Type of Material

Maximum Spacing of Supports mm (in)	Plywood and O-2 Grade OSB	R-1 Grade Waferboard and O-1 Grade OSB	Particleboard	Lumber	Finished Flooring
406 (16") 508 (20") 610 (24")	15.5 (5/8") 15.5 (5/8") 18.5 (3/4")	15.9 (5/8") 15.9 (5/8") 19.0 (3/4")	15.9 (5/8") 19.0 (3/4") 25.4 (1")	17.0 (11/16") 19.0 (3/4") 19.0 (3/4")	Other
610 (24") or less	12.5 (1/2")	12.7 (1/2")	as above	as above	19.0 (3/4") wood strip at right angles to joists
406 (16") or less	12.5 (1/2")	12.7 (1/2")	as above	as above	panel underlay or concrete topping*

Figure 3.23
Thickness of Subflooring (9.23.14.5.)

Plywood subflooring shall be installed with the surface grain at right angles to the joists and with joints parallel to floor joists staggered.

OSB subflooring conforming to O-1 and O-2 grades in CSA-O437.0 and waferboard subflooring conforming to R-1 grade in CSA O437.0 shall be installed with the direction of face orientation at right angles to the joists and with the joints parallel to floor joists staggered.
(9.23.14.4.)



Where support is required, for edges of panel-type subflooring, the support shall consist of tongue-and-groove panel edges, or not less than 38 x 38 mm (2 x 2) blocking securely nailed between framing members.
(9.23.14.3.)

Figure 3.24
Support of Subfloor Edges (9.23.14.)

Element	Minimum Length of Fasteners for Sheathing and Subfloor Attachment, mm (in)				Minimum No. or Maximum Spacing of Fasteners
	Common or Spiral Nails	Ring Thread Nails	Roofing Nails	Staples	
Plywood, waferboard or strandboard from 10 mm (3/8") to 20 mm (3/4") thick	51 (2")	45 (1-3/4")	N/A	51 (2")	150 mm (5-7/8") o.c. along edges and 300 mm (11-3/4") o.c. along intermediate supports
Board lumber 184 mm (7-1/4") or less wide	51 (2")	45 (1-3/4")	N/A	51 (2")	2 per support

Fasteners for Sheathing and Subflooring

Note to Table: Other subfloor elements can be found in the Code

Figure 3.25
Fasteners for Sheathing and Subflooring
(9.23.3.5.)
(9.23.14.6.)
(9.23.14.7.)

NOTCHING AND DRILLING

BUILDING CODE REFERENCES

DIVISION B

9.23.5.1. Holes Drilled in Framing Members

9.23.5.2. Notching of Framing Members

The drilling and notching of floor members to allow the passage of piping, ducts and other services, is affected by provisions of the Code. Care must be taken not to cut and notch wood joists and beams in a manner which reduces the strength and load carrying ability of the structural member. Figure 3.26 illustrates notches, holes and their location in floor members permitted by the Code.

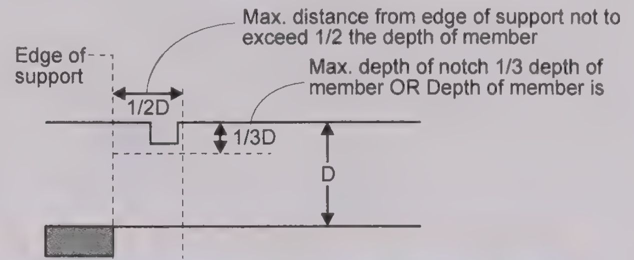
Looking Ahead

Pre-determined actual hole sizes are required from electricians and plumbers at the design stage to decide on the optimum size of the joist.

NOTCHING

Notches only permitted when located on the top of member.

Figure applies to roof, floor or ceiling framing but not for wall studs.

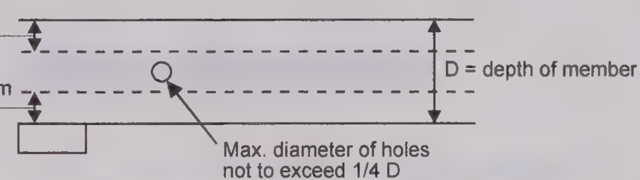


Member Size	Maximum distance from edge	Maximum depth of notch
38 x 89 mm (2 x 4)	44 mm (1-3/4")	30 mm (1-1/8")
38 x 140 mm (2 x 6)	70 mm (2-3/4")	46 mm (1-3/4")
38 x 184 mm (2 x 8)	92 mm (3-5/8")	61 mm (2-3/8")
38 x 235 mm (2 x 10)	117 mm (4-5/8")	78 mm (3")
38 x 286 mm (2 x 12)	143 mm (5-5/8")	95 mm (3-3/4")

(9.23.5.2.)

DRILLING

Holes must be located a min. of 50 mm (2") from edge of member OR depth of member must be increased by size of hole



Member Size	Maximum Hole
38 x 89 mm (2 x 4)	not permitted
38 x 140 mm (2 x 6)	35 mm (1-3/8")
38 x 184 mm (2 x 8)	46 mm (1-3/4")
38 x 235 mm (2 x 10)	58 mm (2-1/4")
38 x 286 mm (2 x 12)	71 mm (2-3/4")

Figure 3.26
Notching and Drilling

(9.23.5.1.)

WORKED EXAMPLE

Floor Construction: Using Joist and Beam Span Tables

Example A - Maximum Allowable Joist Span

Assume a situation in which 38 mm x 184 mm (2 x 8) No. 2 Grade Spruce floor joists are used and where there are no concentrated loads on the floor joists. The floor joists are supporting a living room with no concrete topping and spaced at 406 mm o.c. (16") with strapping and bridging.

What is the maximum allowable span (A) for the floor joists under these conditions?

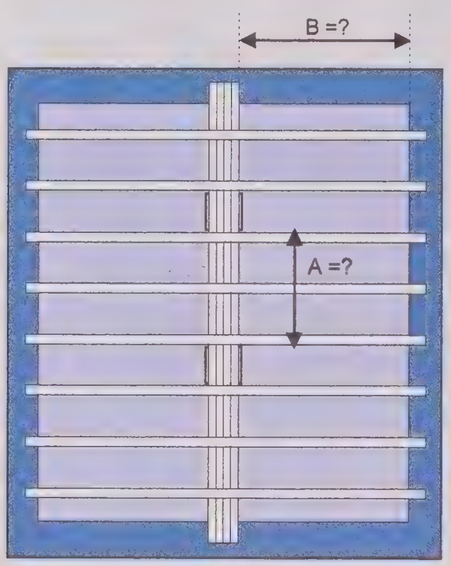
Solve for A

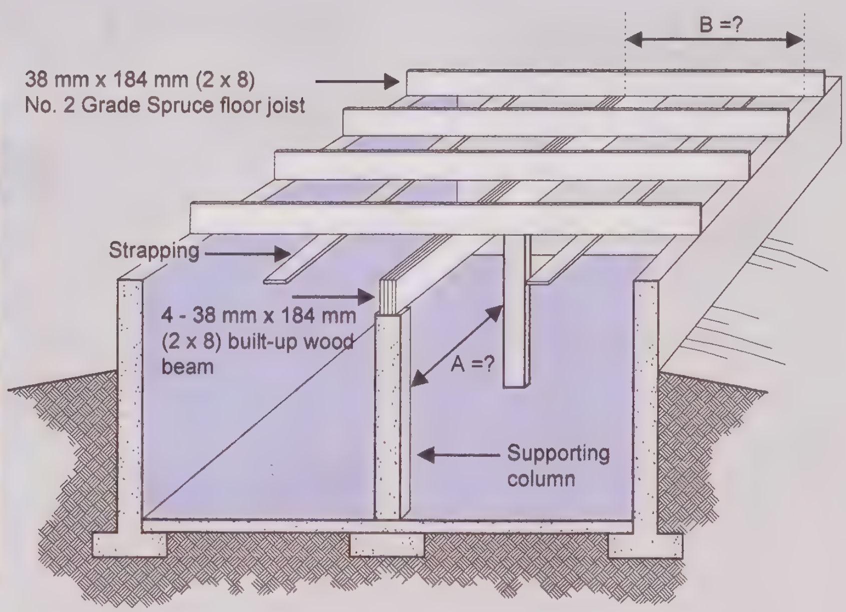
Example B - Maximum Allowable Beam Span

During plans examination for a two storey house, a wood beam (No. 2 Grade Spruce) is shown on the drawings as supporting only one floor. The beam is "built-up" from four pieces of 38 mm x 184 mm (2 x 8) lumber. Assume that beams are laterally supported not subjected to concentrated loads. (For an explanation as to what constitutes lateral support see Figure 3.17.)

What is the maximum allowable span (B) for the beam under these conditions?

Solve for B





Solution for A

Use Figure 3.10
The maximum allowable joist span is 3.72 m (12' 2").

Solution for B

Use Figure 3.6
The maximum allowable beam span is 2.95 m (9' 8") for supported joist length of 3.6 m (11' 10").

4 Room and Space Dimensions

In housing, rooms and spaces are usually intended for specific uses. A major requirement for rooms is that the appropriate space is provided for a room's intended use.

The minimum ceiling heights and floor areas required for a variety of intended uses are based on the evolving needs of occupants and past experience. The accommodation of people, furniture and appliances, while still allowing for movement within a room or space, form the basis of prescribed minimum requirements in the Code.

It is also intended that all dwelling units contain certain types of rooms for specific purposes. Every dwelling unit must have at least one separate bathroom. Space for functions such as sleeping, the preparation and eating of meals, and a living area may be combined but each intended use must be allocated the minimum required ceiling heights and floor areas.

KEY POINTS

Residential buildings must be designed and constructed to fulfill the following functions:

- provide the required amount of space to suit the intended use of all rooms; and
- allow adequate headroom to suit typical uses of rooms.

GENERAL REQUIREMENTS

BUILDING CODE REFERENCES

DIVISION B

9.5.1.1	Application
9.5.1.2.	Method of Measurement
9.5.1.3.	Floor Areas
9.5.1.4.	Combination Rooms
9.5.7.1.	Areas of Bedrooms

The room and space provisions of the Code only apply to dwelling units that are intended for use on a continuing or year-round basis, unless otherwise stated.

Minimum areas of rooms and spaces are prescribed by the Code. In some cases these may be reduced, for example the use the use of built-in furniture or appliances may compensate in areas which are less than the required minimum.

Ceiling heights and floor areas are measured between finished surfaces. Minimum floor areas do not include closets or built-in bedroom cabinets unless stated otherwise. Two or more adjacent areas may be considered as a combination room if the opening between the areas occupies the larger of: a) at least 3 m² (32 ft²) or b) represents 40% or more of the wall separating the rooms not including doors and windows. A direct passage must be provided between the two areas if the dependant area is a bedroom. Figure 4.1 illustrates these conventions as they apply to the Code.

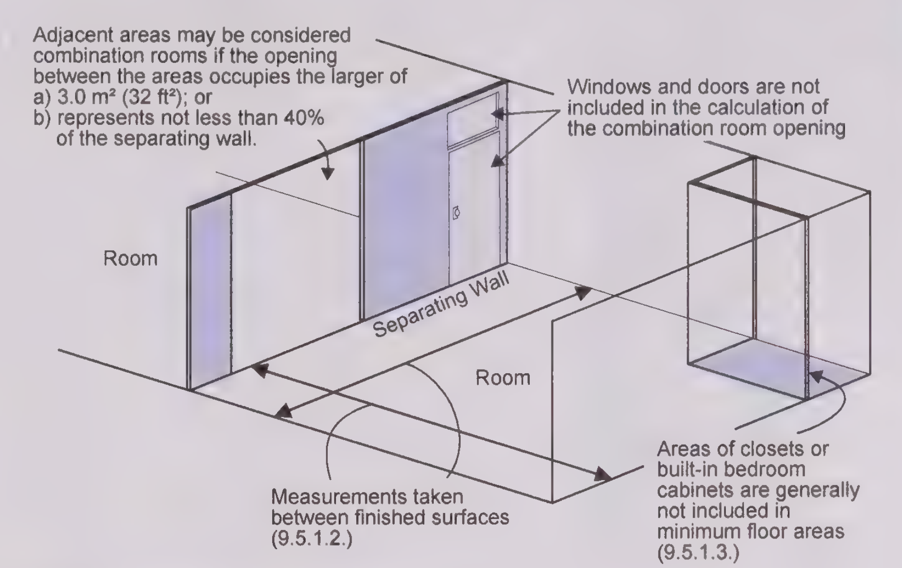


Figure 4.1
General Requirements for the Determination of Dimensions and Areas of Rooms and Spaces (9.5.1.4.)

CEILING HEIGHTS, FLOOR AREAS, AND MINIMUM DIMENSIONS

BUILDING CODE REFERENCES

DIVISION B

9.5.1.5.	Lesser Areas and Dimensions
9.5.3.1.	Ceiling Heights of Rooms or Spaces
9.5.3.2.	Mezzanines
9.5.3.3.	Storage Garages
9.5.4.1.	Areas of Living Rooms and Spaces
9.5.5.1.	Area of Dining Rooms or Spaces
9.5.6.1.	Kitchen Areas
9.5.7.1.	Areas of Bedrooms
9.5.7.2.	Areas of Master Bedrooms
9.5.7.3.	Areas of Combination Bedrooms
9.5.8.1.	Combined Living, Dining, Bedroom and Kitchen Spaces
9.5.9.1.	Space to Accommodate Fixtures
9.5.10.1.	Hallway Width

The Code requirements for minimum ceiling heights and floor areas are illustrated in Figure 4.2. Ceiling heights for each room or space must meet the minimums identified and must adjoin with the ceilings of the entries to that room or space. Rooms by themselves do not constitute a dwelling. The Code also includes specific requirements for means of egress and exits that are needed to allow for movement within, into and out of the dwelling unit. Refer to Chapter 5.

Looking Ahead

See Chapter 5 Means of Egress

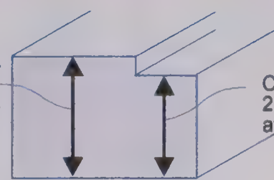
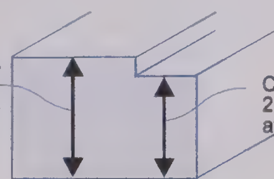
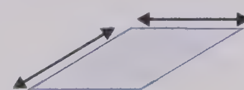
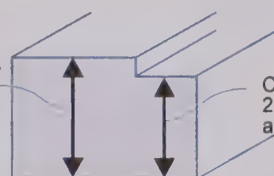
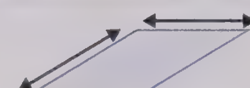
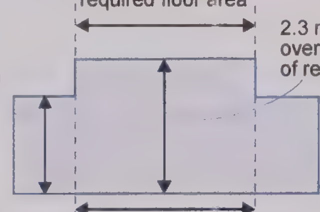
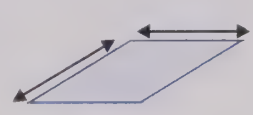
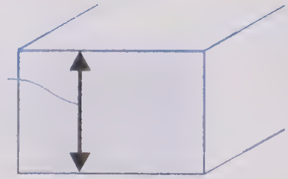
	MINIMUM CEILING HEIGHT	MINIMUM FLOOR AREA
LIVING ROOM	2.3 m (7' 7") over at least 75% of the required floor area (9.5.3.1.)  Clear height of 2.1 m (6' 11") at any point	 Area: 13.5 m² (145 ft²) (9.5.4.1.) or 11.8 m² (118 ft²), when combined with kitchen and dining area and contains sleeping accommodation accommodation for not more than 2 persons (separate bedroom) (9.5.4.1.) or 13.5 m² (145 ft²) when combined with kitchen, dining and bedroom area and contains sleeping accommodation for not more than 2 persons (9.5.8.1.)
DINING ROOM	2.3 m (7' 7") over at least 75% of the required floor area (9.5.3.1.)  Clear height of 2.1 m (6' 11") at any point	 Area: 7 m² (75 ft²) or 3.25 m² (35 ft²), when combined with another space (9.5.5.1.)
KITCHEN	2.3 m (7' 7") over at least 75% of the required floor area (9.5.3.1.)  Clear height of 2.1 m (6' 11") at any point	 Area: 4.2 m² (45 ft²) including base cabinets or 3.7 m² (40 ft²), for dwelling unit containing sleeping accommodation for not more than 2 persons (9.5.6.1.)
BEDROOM (option 1)	Min. 50% of required floor area 2.3 m (7' 7") height over at least 50% of required floor area 1.4 m (4' 7")  Only portion of floor having a ceiling height of 1.4 m (4' 7") or more can be included in floor area calculation	 Area - Standard Bedroom: 7.0 m² (75 ft²)) or 6.0 m² (65 ft²), where built-in cabinets are provided (9.5.7.1.) 4.2 m² (45 ft²)) where combined with other spaces (9.5.7.3.)
BEDROOM (option 2)	2.1 m (6' 11") height over 100% of required floor area (9.5.3.1.) 	 Area - Master Bedroom: 9.8 m² (105 ft²)) or 8.8 m² (95 ft²)), where built-in cabinets are provided Note: where bedrooms are provided, at least 1 must be the size of a master bedroom (9.5.7.2.)

Figure 4.2
Minimum Requirements for Ceiling Heights and Floor Areas

	MINIMUM CEILING HEIGHT	MINIMUM FLOOR AREA

BATHROOM

2.1 m (6' 11") height where anyone would normally stand (9.5.3.1.)

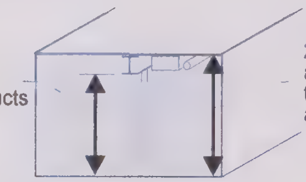


Sufficient space to accommodate fixtures

Area:
Space must be sufficient to accommodate a water closet, lavatory and bathtub or shower stall. See Chapter 12

BASEMENT AREA

1.95 m (6' 5") height under beams and ducts (9.5.3.1.)



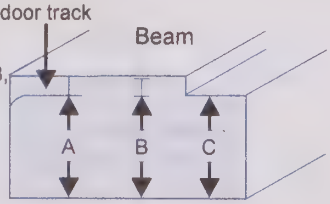
2.1 m (6' 11") over at least 75% of the basement floor area

Area:
No minimum area

STORAGE GARAGE

Overhead door track

Dimensions A, B, and C, must all be at least 2 m (6' 7") (9.5.3.3.)

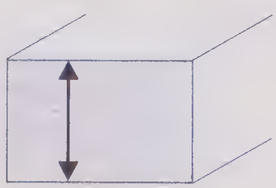


Area:
Minimum size as required for intended use

PASSAGE, HALL MAIN ENTRANCE VESTIBULE, MEZZANINE AND ANY FINISHED ROOM NOT SPECIFICALLY MENTIONED ABOVE

Clear height of 2.1 m (6' 11") at any point. (9.5.3.1.)

This clear height required above and below a mezzanine floor (9.5.3.2.)



Passages, halls and vestibules at least equal to doorway width (see Chapter 5)

For stairways, see Chapter 5

Hallways, minimum width 860 mm (2' 10") or 710 mm (2' 4") with a second exit (9.5.10.1.)

Figure 4.2 Con't.
Minimum Requirements for Ceiling Heights and Floor Areas

5 MEANS OF EGRESS

Among the most important provisions of the Code are those pertaining to the means of egress. These provisions regulate design and construction to allow people to move within and between rooms or spaces, as well as to exit and to enter the dwelling unit.

Means of egress for stacked dwelling units are outside the scope of this Code and Guide which focuses on unstacked, single dwelling units.

KEY POINTS

Residential buildings must be designed and constructed to fulfill the following functions:

- allow occupants a safe means of escape from a building in an emergency;
- allow the safe passage of occupants from one floor to another; and
- provide acceptable resistance to forced entry.

GENERAL REQUIREMENTS

BUILDING CODE REFERENCES

DIVISION B
9.9.1.3. Occupant Load

Exits, doors, stairs and ramps along with hallways, corridors and passageways represent the most common means of egress in dwelling units.

Means of egress is a defined term in the Code which includes exits and access to exits. It refers to a continuous path of travel provided for the escape from any point in a building or in a contained open space to a separate building, an open public thoroughfare, or an exterior open space that is protected from fire exposure from the building with access to an open public thoroughfare. Figure 5.1 illustrates the main components and terms that define means of egress. The following sections further discuss each of these in relation to the relevant Code requirements.

The primary consideration of the Code is the safety of occupants, both under normal conditions of use and in emergency situations, such as in the case of fire. Under normal conditions of use, means of egress are intended to be functional and permit occupants to safely perform tasks such as moving furniture, carrying in groceries or serving food.

Under emergency conditions, the Code intends that occupants are provided with a safe exit from the dwelling unit traveling through a properly designed means of egress. Based on this intent, the means of egress must not only be safe with respect to pedestrian movement, but must also be properly illuminated.

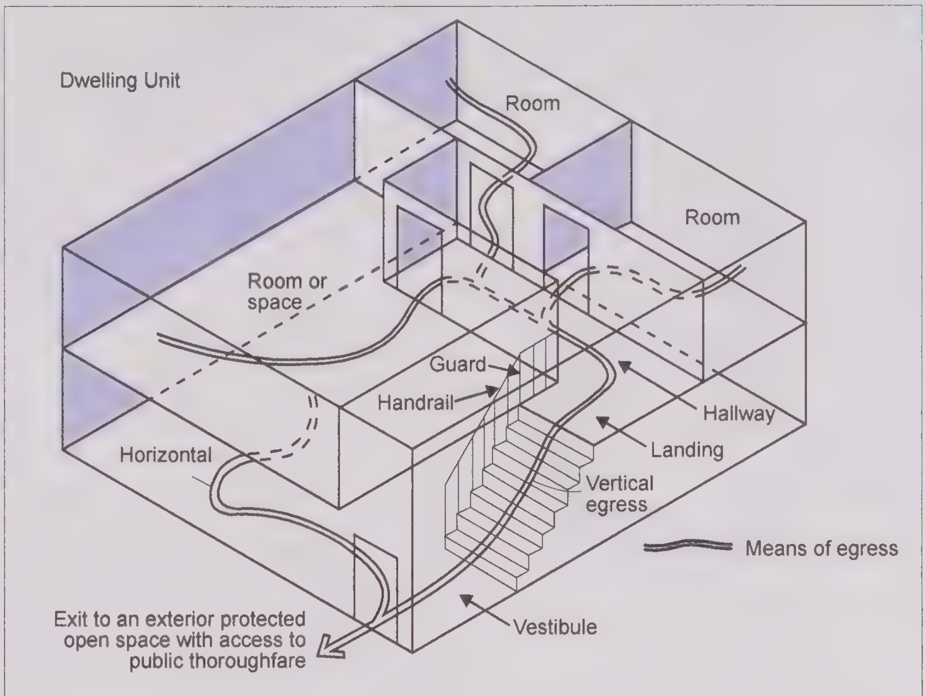


Figure 5.1
Terms Defining Means of Egress (9.8.1.1.) (9.9.1.1.)

EXITS

BUILDING CODE REFERENCES

DIVISION B
9.5.10.1. Hallway Width
9.8.1.1. General
9.9.1.1. Application
9.9.1.2. Fire Protection
9.9.2.1. Types of Exits
9.9.2.3. Elevators, Slide Escapes and Windows as Means of Egress
9.9.9.1. Travel Limit to Exits or Egress Doors
9.9.10.1. Egress Windows or Doors for Bedrooms

Every dwelling unit must contain at least one exit which can be accessed directly without going through another dwelling unit, service room or occupancy. Dwelling units must be designed so that it is not necessary to travel up or down more than one storey to reach a level served by an exit doorway within 1500 mm (4' 11") of ground level. Where it is necessary to travel more than 1 storey to an exit doorway or where the exit doorway is more than 1500 mm (4' 11") above ground level, an additional exit is required.

This additional exit is waived where the uppermost floor level is served by an openable window or door with a sill not more than 1000 mm (3' 3") above the floor and not more than 7 m (23') above the adjacent ground level, providing an unobstructed opening of not less than 1000 mm (3' 3") in height and 550 mm (21-5/8") in width or the floor level has direct access to a balcony. Refer to Figure 5.2.

An additional exit is required for floor levels in dwelling units where the building contains a hallway less than 860 mm (2' 10") in width as per Figure 5.3. This additional exit must be provided near the end of the hallway furthest from the living area or in every bedroom served by the hallway. Refer to Figure 5.3.

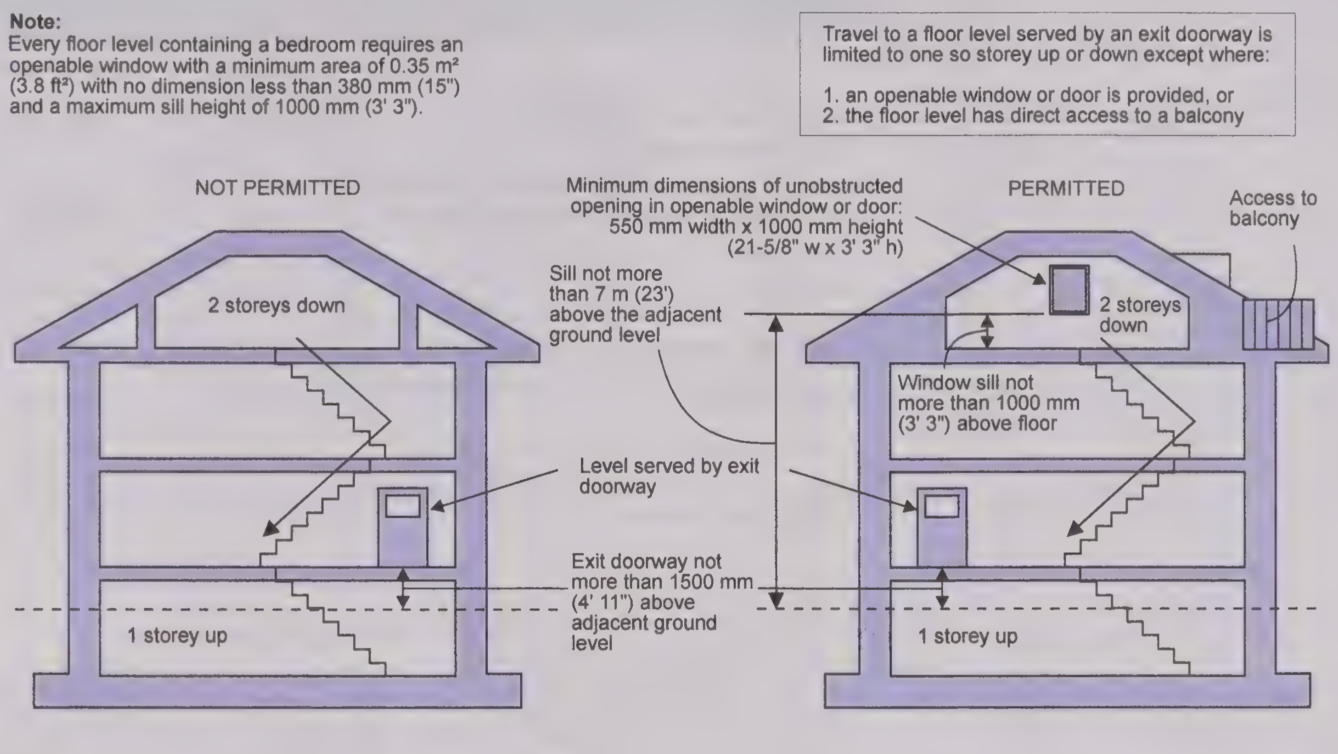


Figure 5.2
Exit Requirements

(9.9.10.1.)
(9.9.9.1.)

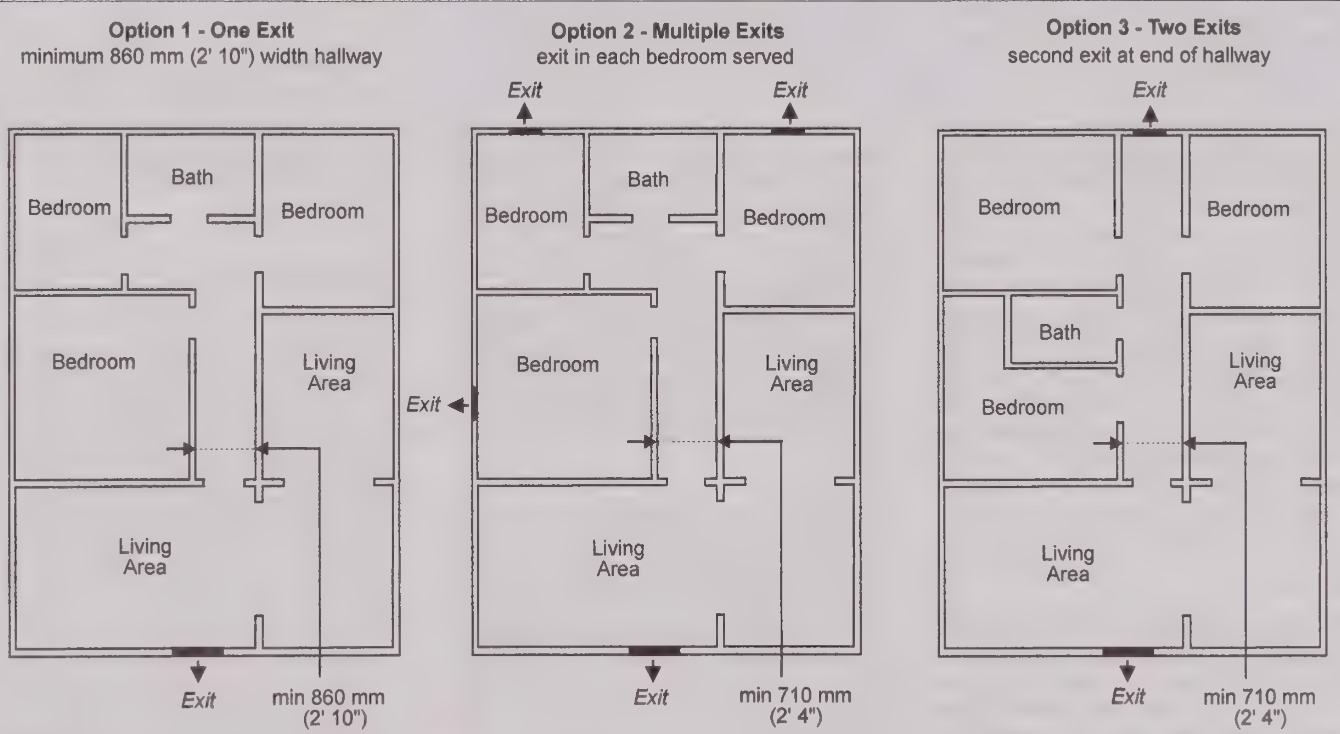


Figure 5.3
Exiting Requirements for Buildings With Narrow Hallways

(9.5.10.1.)

DOORS

BUILDING CODE REFERENCES

DIVISION B

9.5.9.2.	Doors to Rooms Containing Water Closets
9.5.11.1.	Doorway Opening Sizes
9.6.1.1.	Application
9.6.1.2.	Material Standards for Glass
9.6.1.3.	Structural Sufficiency of Glass
9.7.1.1.	Application
9.7.2.1.	Entrance Doors
9.7.2.2.	Other Requirements for Windows, Doors and Skylights
9.7.3.1.	General Performance Criteria
9.7.3.2.	Heat Transfer Performance
9.7.3.3.	Thermal Characteristics of Windows, Doors and Skylights
9.7.4.1.	Application
9.7.4.2.	General
9.7.4.3.	Performance Requirements
9.7.5.1.	Application and Compliance
9.7.5.2.	Resistance to Forced Entry for Doors
9.7.6.1.	Installation of Windows, Doors and Skylights
9.7.6.2.	Sealants, Trim and Flashing

SUPPLEMENTARY STANDARD SB-12

2.1.1.9.	Minimum Thermal Resistance of Doors

This section deals with requirements for doors in dwelling units. It applies to doors, glazed areas in doors, sidelights for doors and glass for shower or bathtub enclosures.

Many of the requirements for doors are based on established standards. These standards are referenced in the corresponding section of the Code and include CAN/CSA-A440.4, "Window, Door and Skylight Installation" and AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights". Standards have been developed to ensure that doors will provide acceptable levels of performance for their intended use.

General

Doors installed as part of an assembly separating heated and non-heated space are required to resist the ingress of precipitation and insects, resist wind loads, resist forced entry (where required), control air leakage, and are easily operable.

Minimum Size of Doors Depending on Entrance

	Width (mm (in))	Height (mm (in))
▪ Dwelling unit (required entrance) ▪ Vestibule or entrance hall	810 (32")	1980 (78")
▪ Stairs to a floor level that contains a finished space ▪ All doors in at least one line of passage from the exterior to the basement ▪ Utility rooms	810 (32")	1980 (78")
▪ Walk-in closet	610 (24")	1980 (78")
▪ Bathroom, water closet room, shower room	610 (24")	1980 (78")
▪ Rooms located off hallways that are permitted to be 710 mm (28") wide	610 (24")	1980 (78")
▪ Rooms not mentioned above, exterior balconies	760 (30")	1980 (78")

Figure 5.4
Minimum Size of Doors (9.5.11.1.)

Doors are to be installed in accordance with CAN/CSA-A440.4, with two exceptions: treated plywood shims are permitted to be used as support, and protection from percipitation for a wall with a door, and the interface of the wall and door, must comform to Section 9.27. Cladding. Doors are to be sealed to both air and vapour barriers. It is important that all doors meet all required standards and are installed in accordance with manufacturers' instructions.

Doors must be provided at each entrance to a dwelling unit and in each room containing a water closet. Main entrance doors must be provided with a door viewer, transparent glazing, or a sidelight. Exit doors are permitted to swing either inward or outward. All exterior doors must be readily openable from the inside without requiring keys, special devices, or specialized knowledge of the door opening mechanism. (See also Resistance to Forced Entry below).

Where a door opens onto a drop of more than 600 mm (23-5/8") to the nearest floor, landing, stair tread, or ground level (as in a french balcony), the door must be provided with a guard or it must be equipped with a mechanism that will prevent any clear unobstructed opening greater than 100 mm (4").

Minimum Size of Doors

The minimum sizes for doors are shown in Figure 5.4. Doorway openings must be designed to accommodate the minimum prescribed door sizes regardless of door type - swinging, sliding or folding.

Exit Doors

Exit doors and doors in means of egress within dwelling units or serving a single dwelling unit are not required to swing on the vertical axis.

Exterior Doors

Exterior doors used in housing are commonly of the wood, insulated steel, fibre glass or sliding glass type. Each of these types is required to conform to the applicable manufacturing standard for construction and air infiltration referenced in the corresponding section of the Code. All exterior doors, except garage doors, must be weatherstripped to control air leakage. Special consideration must be given to doors between the dwelling unit and an attached garage as detailed in Chapter 16. It is also required that exterior doors provide the minimum thermal resistance value listed in Chapter 13.

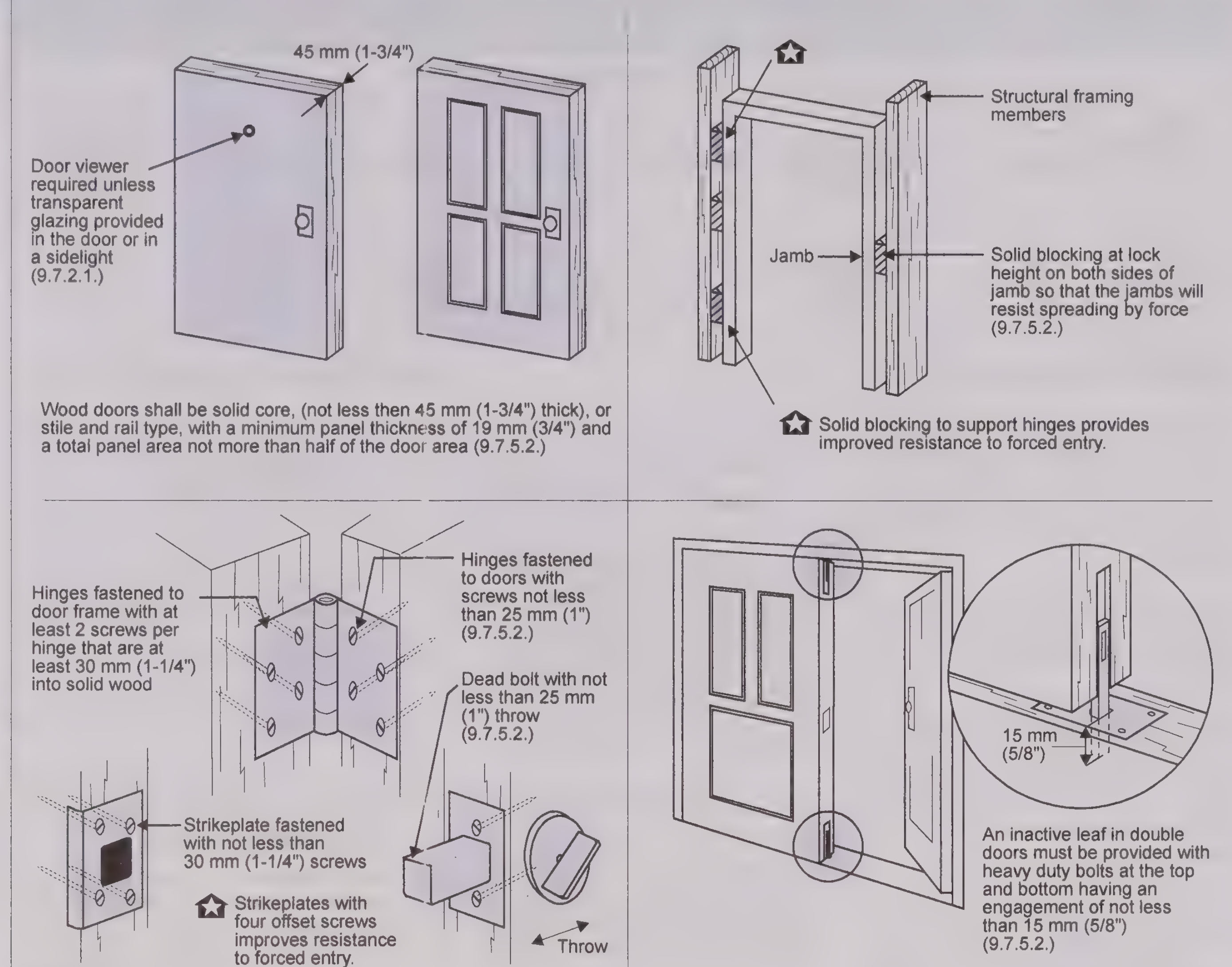


Figure 5.5
Code Requirements for Resistance to Forced Entry (9.7.5.2.)

Resistance to Forced Entry

A minimum level of security must be provided for all swing-type exterior doors leading into the dwelling unit. This Code requirement is intended to substantially reduce the likelihood of forced entry through exterior doors.

Where wood doors leading into the dwelling unit are installed, these must be either solid core type not less than 45 mm (1-3/4") thick, or stile and rail type having a panel thickness of not less than 19 mm (3/4") and a total panel area not exceeding 50% of the door area.

Double doors leading into the dwelling unit must be provided with an inactive leaf which may be secured with heavy duty bolts, top and bottom, having an engagement not less than 15 mm (5/8").

Solid blocking must be provided on both sides at the lock height between the jambs and structural framing for all doors leading into the dwelling unit. This blocking must be installed to adequately resist spreading of the door jambs by force.

For all outward swinging exterior doors leading into the dwelling unit, hinges or pins must be provided so that the doors cannot be removed when they are in the closed position. Hinges must be securely fastened to wood doors with minimum 25 mm (1") long wood screws and to wood frames with at least two wood screws penetrating not less than 30 mm (1-1/4") into solid wood.

Hinges for metal doors and frames must be securely fastened with No. 8 or larger machine screws not less than 10 mm (3/8") long.

Strikeplates for all exterior doors leading into the dwelling unit must be fastened to wood frames with wood screws penetrating not less than 30 mm (1-1/4") into solid wood. Strikeplates must be fastened to metal frames with No. 8 or larger machine screws not less than 10 mm (3/8") long.

Maximum Glass Area for Doors - m² (ft²)

Glass Thickness, mm (in)	Type of Glass						
	Annealed	Annealed multiple glazed; Factory sealed units	Laminated	Wired	Heat strengthened	Fully tempered	Fully tempered multiple glazed; Factory sealed units
3 (1/8")	0.50 (5.4)	0.70 (7.5)	----*	----*	1.00 (10.8)	1.00 (10.8)	2.00 (21.5)
4 (3-16")	1.00 (10.8)	1.50 (16.1)	----*	----*	1.50 (16.1)	4.00 (43.1)	4.00 (43.1)
5 (7-32")	1.50 (16.1)	1.50 (16.1)	----*	----*	1.50 (16.1)	no limit	no limit
6 (1/4")	1.50 (16.1)	1.50 (16.1)	1.20 (13.0)	1.00 (10.8)	1.50 (16.1)	no limit	no limit

Figure 5.6
Maximum Glass Area for Doors

Notes to Table: (*) Not generally available (9.6.1.3.)

Deadbolt locks must consist of a cylinder having no less than 5 pins and a bolt throw of not less than 25 mm (1"), protected with a solid or hardened free-turning ring or beveled cylinder housing.

Main entrance doors without transparent glazing provided in the door or a sidelight must be equipped with a door viewer.

Appendix A to the Code provides additional explanatory material for measures regarding resistance to forced entry. Figure 5.5 depicts some of the Code requirements for resistance to forced entry.

Glass in Doors

The maximum area of glass in doors is provided in Figure 5.6. The thickness and type of glass is used to determine the maximum area of glazing permitted for the safe performance of the door assembly.

Mirrored Glass Doors

Mirrored glass doors may be used only at the entrance to reach-in clothes closets and must be reinforced with a film backing providing adequate impact resistance. Ensure that mirrored glass doors conform to the standards referenced in the Code.

Better Building Note

As a means of egress, doors and doorways should be designed to provide safety and convenience. Door locations and types in dwellings along with directions of swing should be carefully considered.

Glass for Shower or Bathtub Enclosures

Safety glass must be used for glass shower and bathtub enclosures. This requirement is especially important to check when custom enclosures are being fabricated.

Looking Ahead

See Chapter 13 Insulation, Air Barriers, and Vapour Barriers

See Chapter 16 Garages and Carports

Control of Heat Gain and Heat Loss Through Doors

Doors separating heated space from unheated space or the exterior must be designed, constructed, and installed to both minimize condensation on the interior surface, and ensure comfortable conditions for the occupants. They are required to have a thermal resistance of not less than RSI 0.7 (R4). Refer to Supplementary Standard SB-12 for more information.

STAIRS

BUILDING CODE REFERENCES

DIVISION B

9.8.2.1.	Stair Width
9.8.2.2.	Height over Stairs
9.8.3.1.	Straight and Curved Runs in Stairs
9.8.3.2.	Minimum Number of Risers
9.8.3.3.	Maximum Height of Stairs
9.8.4.1.	Dimensions for Risers
9.8.4.2.	Dimensions for Rectangular Runs and Treads
9.8.4.3.	Dimensions for Angled Treads
9.8.4.4.	Uniformity and Tolerances for Risers and Treads
9.8.4.5.	Winders
9.8.4.6.	Leading Edges of Treads
9.8.6.2.	Required Landings
9.8.6.3.	Dimensions of Landings
9.8.6.4.	Height over Landings
9.8.9.1.	Loads on Stairs and Ramps
9.8.9.2.	Exterior Concrete Stairs
9.8.9.3.	Exterior Wood Steps
9.8.9.4.	Wooden Stair Stringers
9.8.9.5.	Treads
9.8.9.6.	Finish for Treads and Landings and Ramps
9.8.10.1.	Design
9.8.10.2.	Anchorage
9.8.10.3.	Prevention of Damage Due to Frost
9.9.2.5.	Front Edge of Stair Treads

Stairs are the most common means of vertical egress in dwelling units. Code requirements for stairs have been derived from evolving practices found to provide reasonable safety and convenience.

Means of egress for stacked dwelling units are outside the scope of this Code and Guide which focuses on unstacked, single dwelling units.

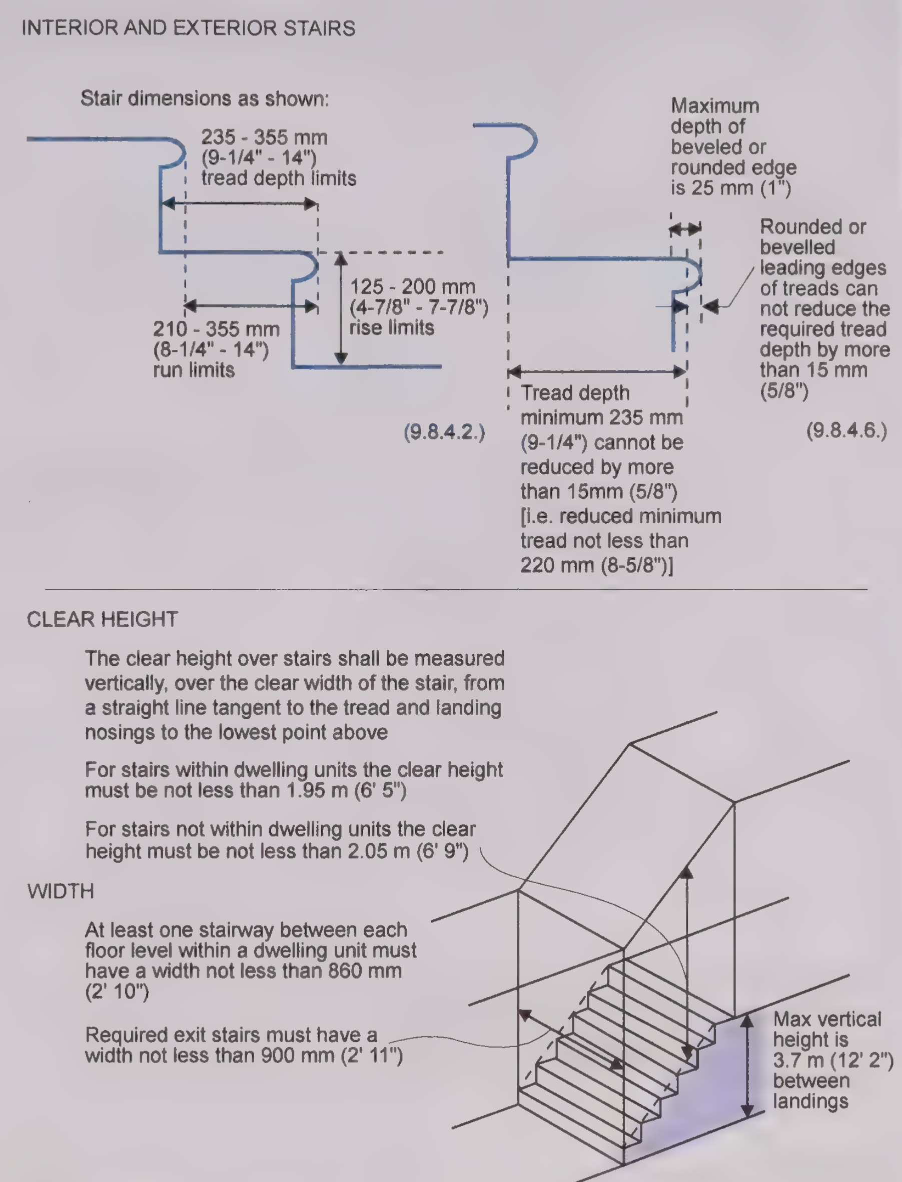


Figure 5.7
Stair Dimensions

General

All stairs must be designed and constructed such that treads and risers have a uniform rise and run. Stairways may contain both curved and straight portions of stairs provided the riser height is uniform throughout the entire flight and the curved portion conforms to Section 9.8. of the Building Code.

Stair Dimensions

Code requirements for stair dimensions are illustrated in Figure 5.7. The rise and run of stairs, the provision of nosings or backslopes, the minimum width of stairs and the minimum headroom are all prescribed by the Code.

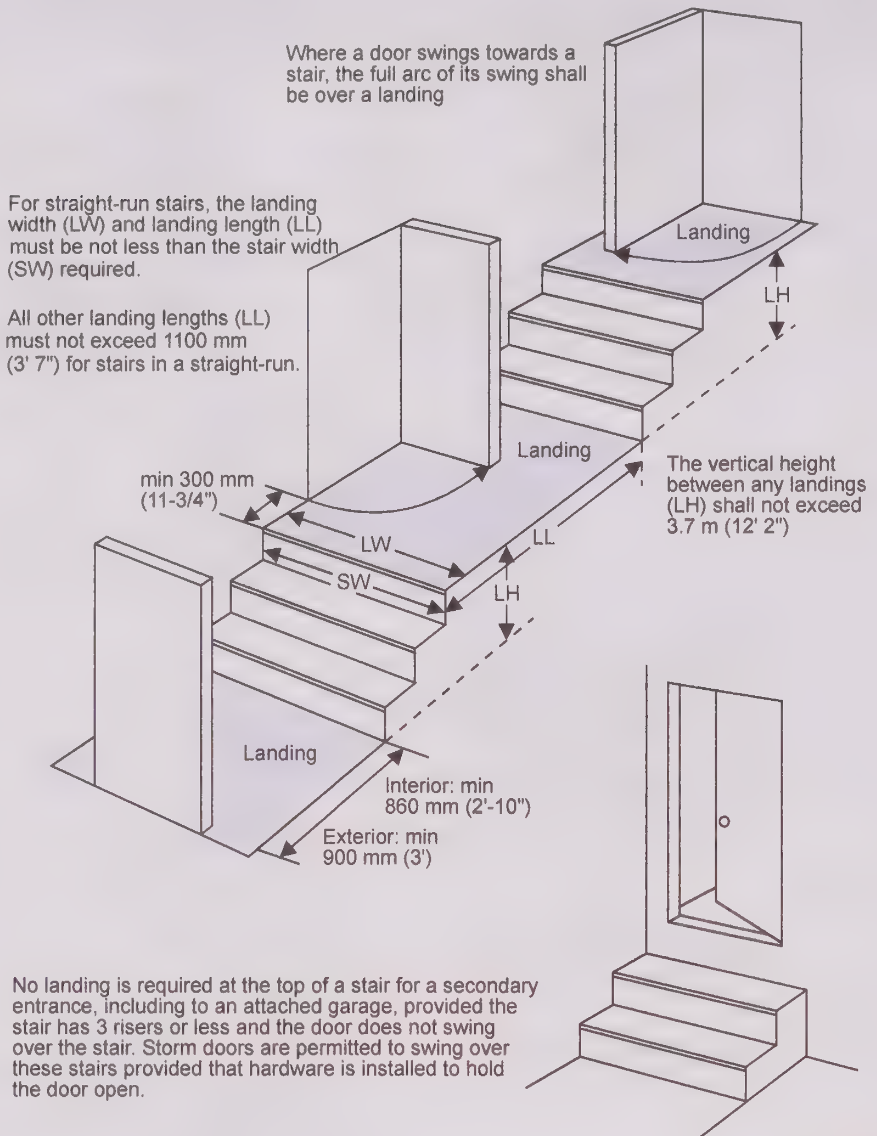


Figure 5.8
Landing Dimensions

(9.8.3.3.)
(9.8.6.2.)
(9.8.6.3.)

Landings

Landings are intended to provide occupants with level, secure footing at the top and bottom of stairs, ramps with a slope greater than 1 in 50 and at doorways which swing toward stairs. Where a door at the top of a stair swings away from the stair, no landing is required between the doorway and stair, however, provision of a landing is recognized as better building practice. A landing must be provided at the top of all exterior stairs. A landing is not required for an exterior stair serving a secondary entrance, including an entrance from an attached garage, with 3 risers or less and with a door that swings away from the stair or that slides. If the door is a storm or screen door it must be equipped with hardware to hold it open. A landing must be provided at the bottom of all exterior stairs and ramps, unless there is no obstruction such as a gate or a door within 900 mm (2' 11") of the stair or ramp.

Landings must be at least as wide and as long as the width of the stairs in which they serve, except that the length of a landing serving a single dwelling unit must be not less than 900 mm (2' 11") for exterior stairs and not less than 860 mm (2' 10") for interior stairs. The maximum permitted vertical height between landings is 3.7 m (12' 2") in order to minimize the risk of an accidental fall and provide occupants with a resting level. The clear height over landings must not be less 1.95 m (6' 5") within dwelling units and not less than 2.05 m (6' 9") not with dwelling units. Figures 5.8 and 5.9 illustrate requirements for landings.

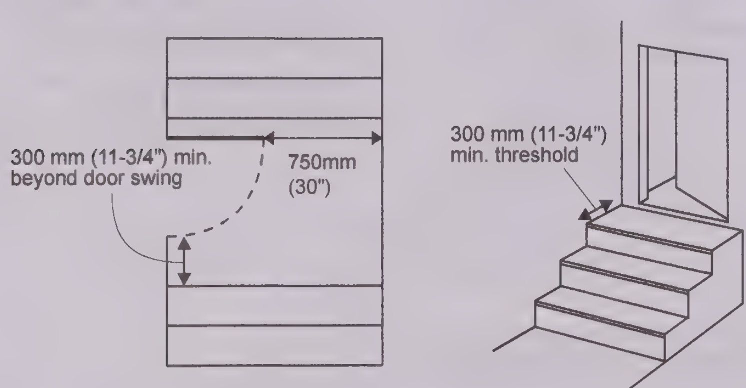
Dimensions for Required Landings Serving a Single Dwelling Unit

Landing Configuration	Minimum Length	Minimum Width
In straight-run interior stair or ramp, or interior landing turning through less than 30°	860 mm (35")	Width of stair or ramp
In straight-run exterior stair or ramp, or exterior landing turning through less than 30°	900 mm (36")	
Landing turning through an angle of 30° or more, but less than 90°	230 mm (9") along inside edge AND 370 mm (14-5/8") measured at a point 230 mm (9") from the inside edge	Width of stair or ramp measured at right angle to path of travel
Landing turning through not less than 90°	Width of landing	
Landing turning through 30° or more	Width of stair or landing	

Figure 5.9
Dimensions of Landings Serving a Single Dwelling Unit (9.8.6.3.)

Better Building Note

Landings and thresholds in stairs can be designed to provide a higher level of safety and convenience. It is difficult to open doors swinging into landings if the occupant is required to step back and down to allow sufficient door swing clearance. Similarly, at doorways occurring at the top of stairs, it is safer to provide a threshold in place of the first step, especially when the stair light switch is located beyond the doorway.



Curved Stairs and Winders

In order to accommodate turns safely in stairs, the Code requirements in Figure 5.10 must be observed. It is important during the design of curved stairs and winders, particularly where these are manufactured off-site, to ensure compliance with the Code.

Construction, Uniformity and Tolerances

The construction of stairs must conform to the corresponding section of the Code. Stairs and ramps serving a single dwelling unit must be designed for strength and rigidity to support 1.9 kPa (40 psf). See Figure 5.12.

Risers must have a uniform height within any one flight with a maximum tolerance of 6 mm (1/4") between adjacent treads or landings and 6 mm (1/4") between the tallest and shortest risers. Similarly, treads must have a uniform run and tread depth with a maximum tolerance of 6 mm (1/4") between adjacent treads and 6 mm (1/4") between the deepest and shallowest runs and treads in a flight. See Figure 5.11.

It is also important to provide appropriate finishes for stairs which are both safe and durable.

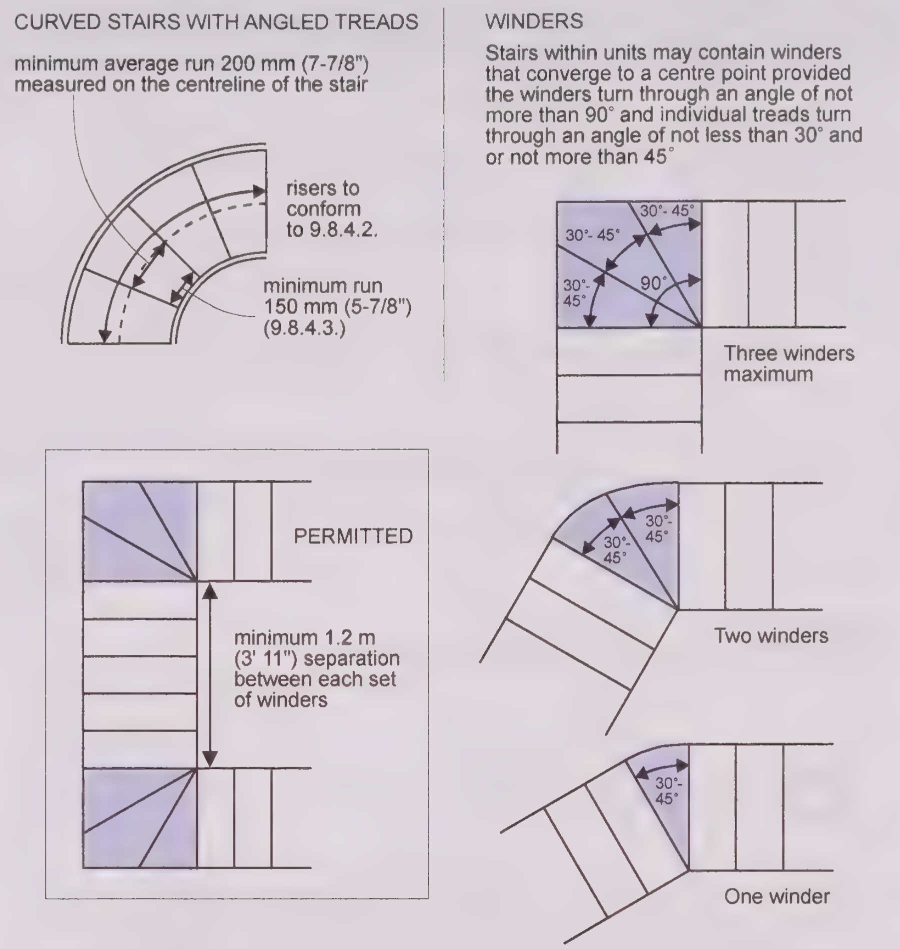


Figure 5.10
Curved Stairs and Winders (9.8.4.5.)

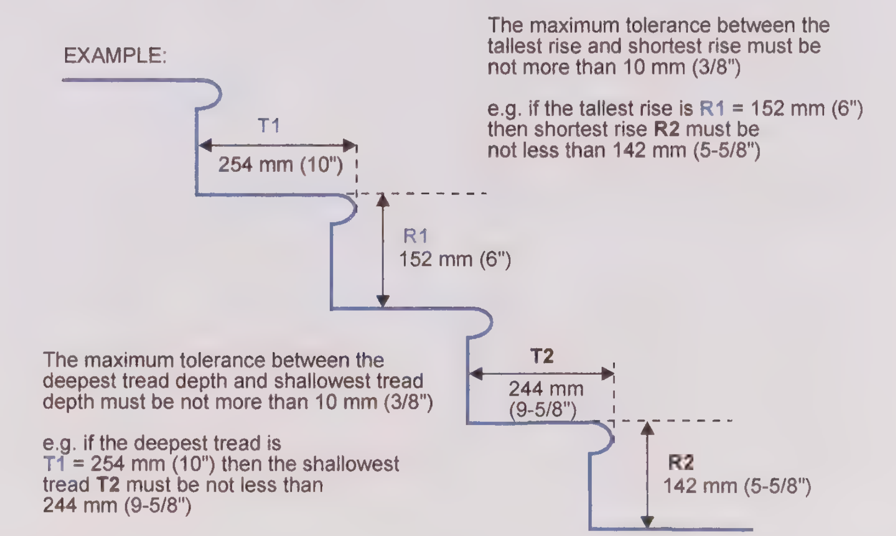


Figure 5.11
Uniformity and Tolerances for Treads and Risers (9.8.4.4.)

WOOD STAIRS

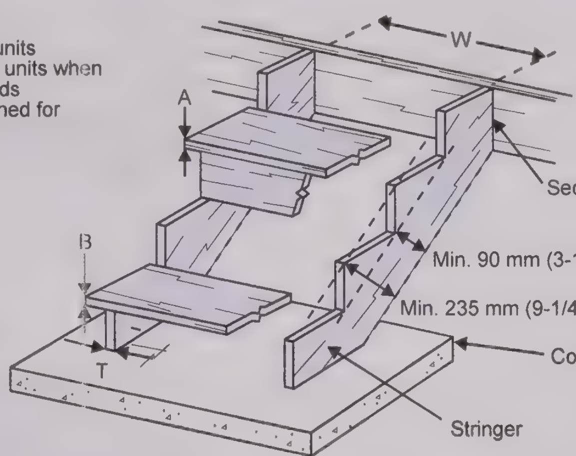
W = max. 900 mm (2' 11") in dwelling units
W = max. 1200 mm (3' 11") in dwelling units when risers support the front of the treads unless stringers and treads designed for wider spacing

Tread thickness:

A = min. 25 mm (1") when risers support front of tread
B = min. 38 mm (1-1/2") when tread unsupported at front and distance between stringers is greater than 750 mm (2' 6")

Stringer thickness:

T = 25 mm (1") if supported along the length (i.e. secured to a wall)
T = 38 mm (1-1/2") if unsupported along the length



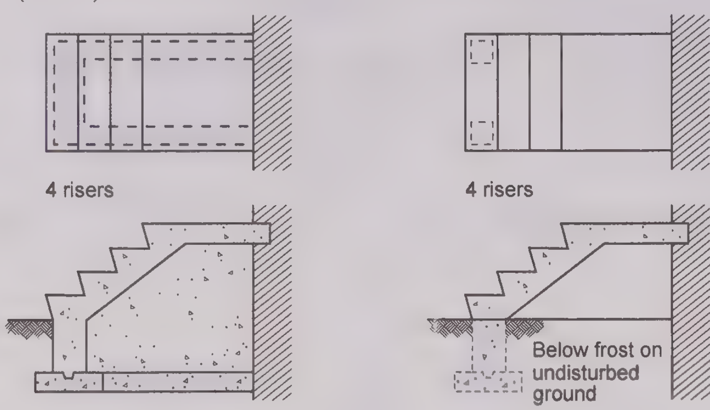
Stair treads of plywood or OSB that are not continuously supported by the riser must have their face grain or direction of face orientation at right angles to the stringers

Exterior wood steps shall not be in direct contact with the ground unless treated to prevent decay (9.8.9.3.)

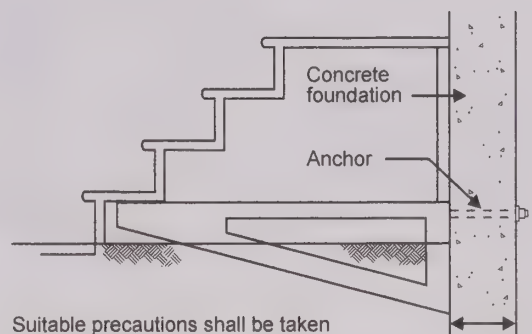
(9.8.9.4.)
(9.8.9.5.)

EXTERIOR CONCRETE STAIRS

Concrete steps with more than 2 risers and 2 treads must be supported on unit masonry, concrete walls or piers not less than 150 x 150 mm (5-7/8" x 5-7/8") (9.8.9.2.)



CANTILEVERED EXTERIOR CONCRETE STEPS



Suitable precautions shall be taken during backfilling and grading to avoid damage due to soil freezing (9.8.10.3.)

Figure 5.12
Stair Construction

(9.8.10.)

RAMPS

BUILDING CODE REFERENCES

DIVISION B

9.8.5.1.	Application
9.8.5.2.	Ramp Width
9.8.5.3.	Height over Ramps
9.8.5.4.	Slope
9.8.5.5.	Maximum Rise
9.8.6.2.	Required Landings
9.8.6.3.	Dimensions of Landings

Ramps represent the second most common form of vertical egress. The maximum slope for interior and exterior ramps in dwelling units is 1 in 10. Where any means of egress opens onto the side of a ramp, the landing shall extend for a distance of not less than 300 mm (11-3/4") on either side of the doorway or stairway, except on a side abutting an end wall. Figure 5.13 illustrates the Code requirements governing ramps.

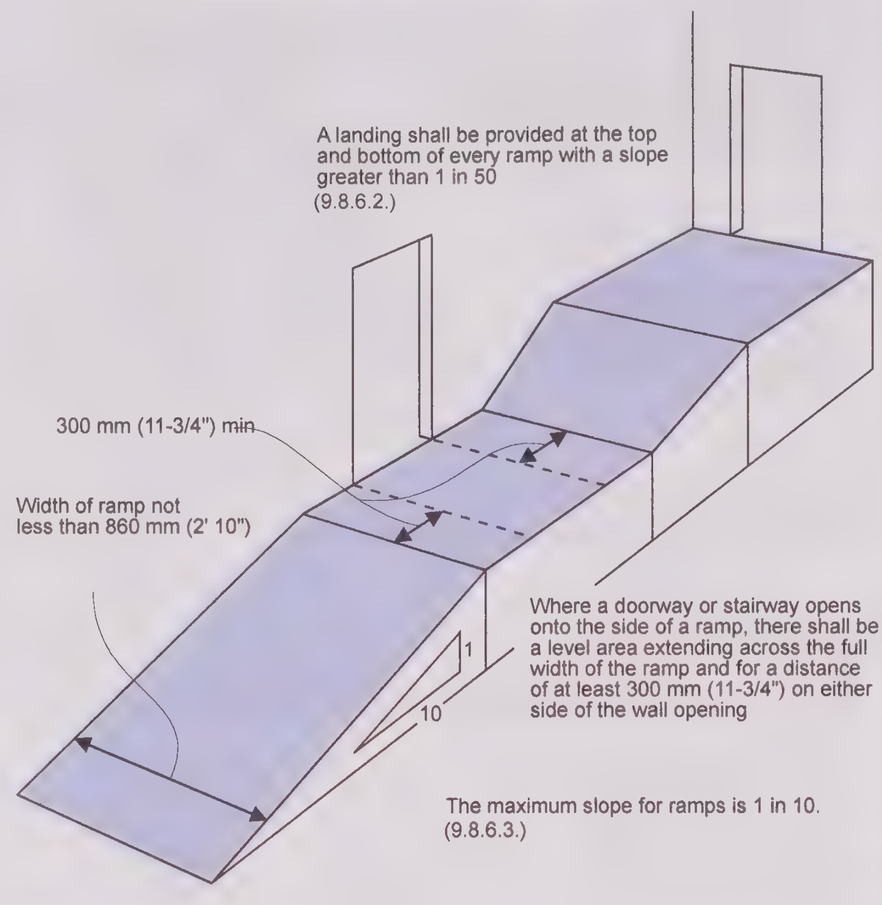


Figure 5.13
Requirements for Pedestrian Ramps (9.8.5.)

HANDRAILS

BUILDING CODE REFERENCES

DIVISION B

9.8.7.1.	Required Handrails
9.8.7.2.	Continuity of Handrails
9.8.7.4.	Height of Handrails
9.8.7.5.	Ergonomic Design
9.8.7.6.	Projections into Stairs and Ramps
9.8.7.7.	Design and Attachment of Handrails

Handrails are intended to provide occupants with a secure grip and means of support when ascending and descending stairs or ramps. Code requirements for handrails apply to both stairs and ramps in dwelling units, however, only requirements for stairs are depicted in Figure 5.14.

Handrails REQUIRED on:
a) at least one side of stairs or ramps less than 1100 mm (3' 7") wide
b) two sides of stairs or ramps 1100 mm (3' 7") wide or greater

Handrails NOT REQUIRED for:
a) interior stairs serving one dwelling unit having not more than two risers
b) exterior stairs serving one dwelling unit having not more than three risers
c) ramps with a slope not less than 1 in 12 or rising not more than 400 mm (15-3/4")

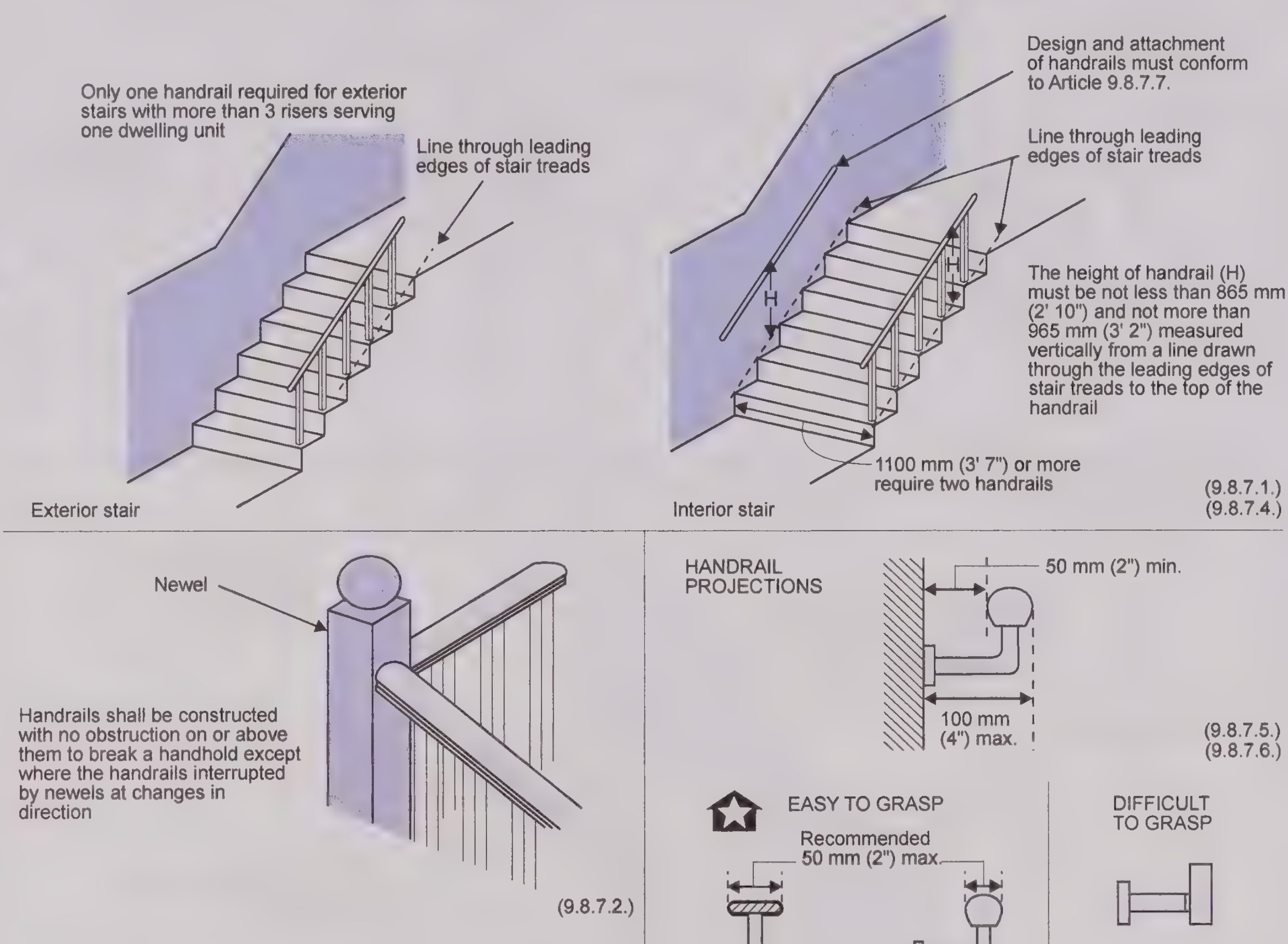


Figure 5.14
Handrails

GUARDS

BUILDING CODE REFERENCES

DIVISION B

9.8.8.1.	Required Guards
9.8.8.2.	Loads on Guards
9.8.8.3.	Height of Guards
9.8.8.4.	Guards for Floors and Ramps in Garages
9.8.8.5.	Openings in Guards
9.8.8.6.	Guards Designed Not to Facilitate Climbing
9.8.8.7.	Glass in Guards

Guards are intended to reduce accidental falls from differences in elevation between adjacent floor levels or the exterior ground. Generally, guards are required for stairs, ramps, landings, balconies, porches, decks, mezzanines, galleries and raised walkways where the difference in elevation between the two walking surfaces is more than 600 mm (23-5/8").

In many cases, handrails are incorporated into guards where both are required. Guard heights are related to average waist heights, and are measured in a similar fashion to clear heights over a line drawn tangent to the stair nosing. Guards must withstand specified loads as described in Figure 5.19. Figures 5.15 to 5.20 illustrate the major Code requirements for guards.

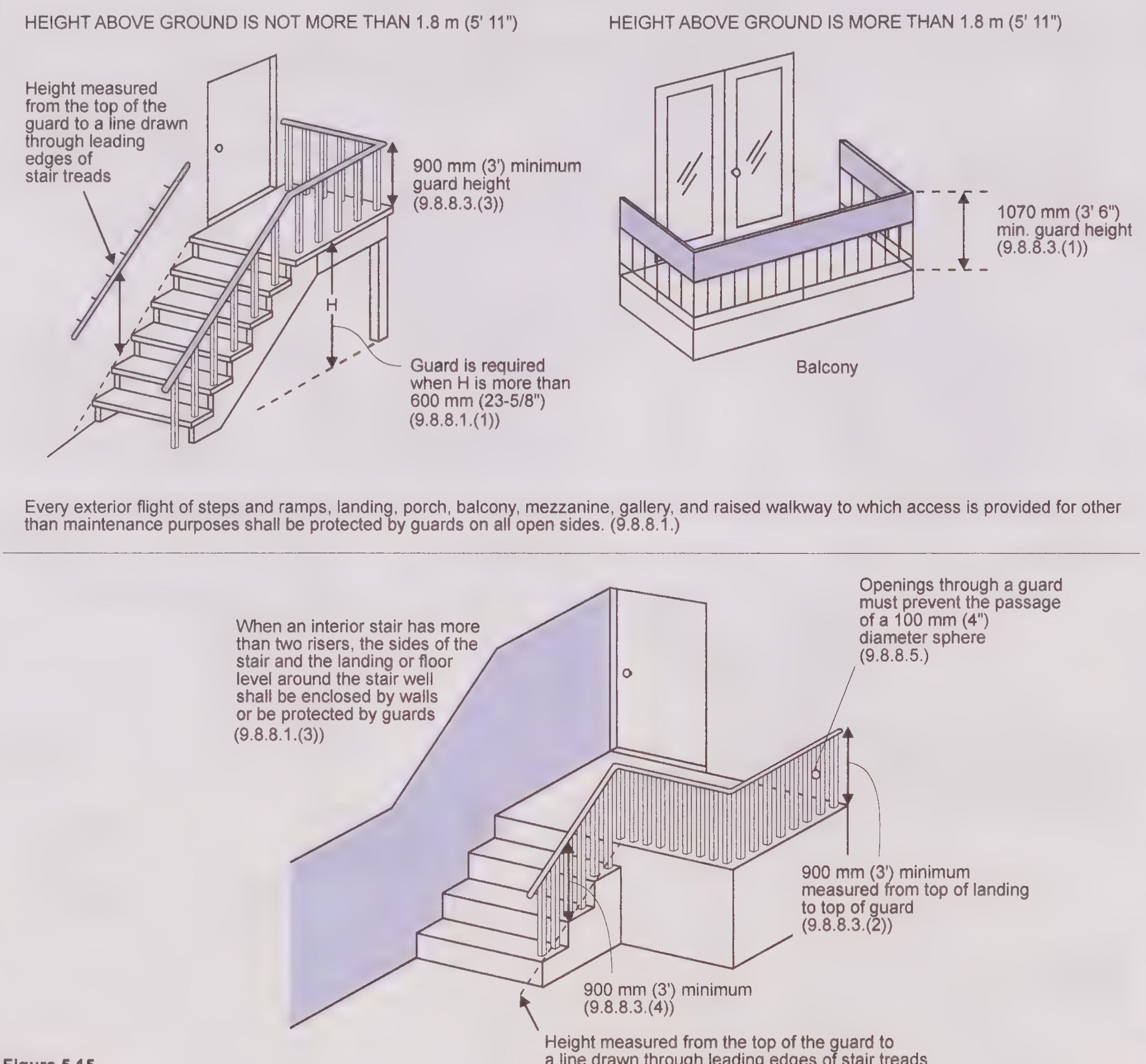


Figure 5.15
Required Guards

(9.8.8.)

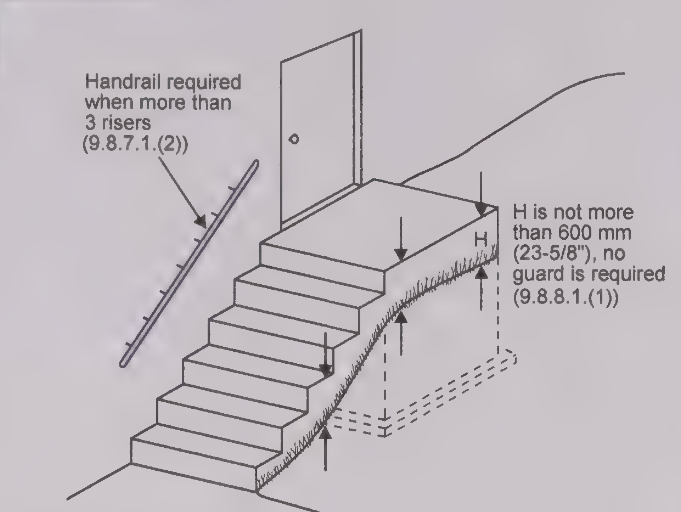


Figure 5.16
Guards not Required

Height above adjacent ground level or walking surface	Guard Requirement
600 mm (23-5/8") or less	Not Required 9.8.8.1.(1)
1800 mm (5' 11") or less (See Figure 5.15)	Required 900 mm (2' 11") min. guard height 9.8.8.3.(2)
exterior more than 1800 mm (5' 11") (See Figure 5.14)	Required 1070 mm (3' 6") min. guard height 9.8.8.3.(3)

Figure 5.17
Summary Guard Requirements

Glass in Guards

Glass in guards has safety limitations placed upon it to protect occupants in the event that the glass breaks. In Part 9, glass in guards is required to be safety glass, either laminated or tempered, conforming to CAN/CGSB-12.1-M "Tempered or Laminated Safety Glass", or wired glass conforming to CAN/CGSB-12.11-M "Wired Safety Glass".

Opening in Guards

Guards help to prevent accidental falls where there is a difference in elevation, but the design of the guard must also prevent injuries from occupant use. Guards are to provide protection when there are no walls that would fulfill this requirement. Since guards provide less protection than walls, additional requirements apply to guards to ensure a minimum level of protection is provided. For example, there are restrictions placed on openings in guards to prevent children from lodging their heads in the guard, and to prevent children from falling through the guard. These are shown in Figure 5.18.

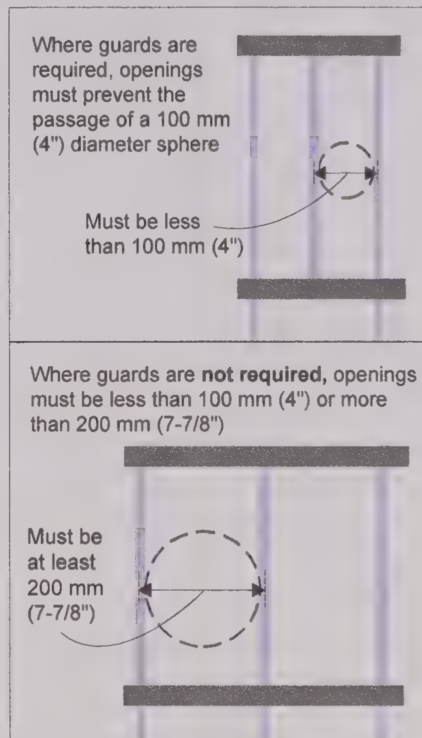
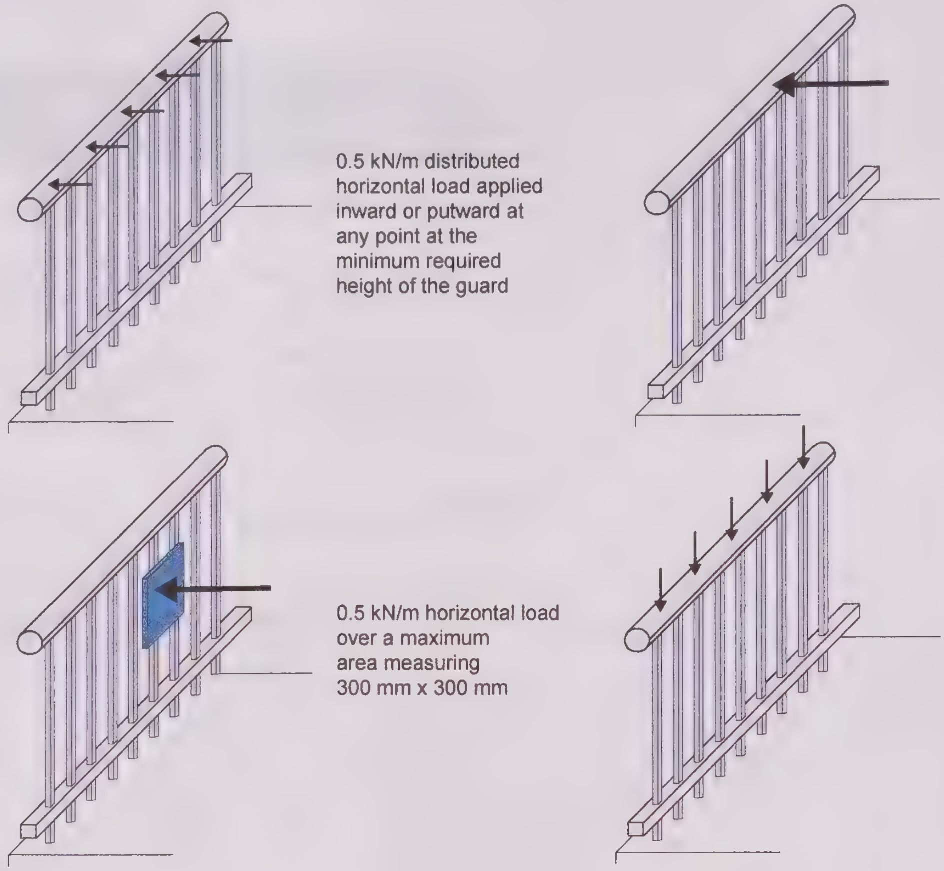


Figure 5.18
Openings in Guards (9.8.8.5.)



None of the specified loads are considered to be applied simultaneously.Whichever load creates the most critical condition should be applied.

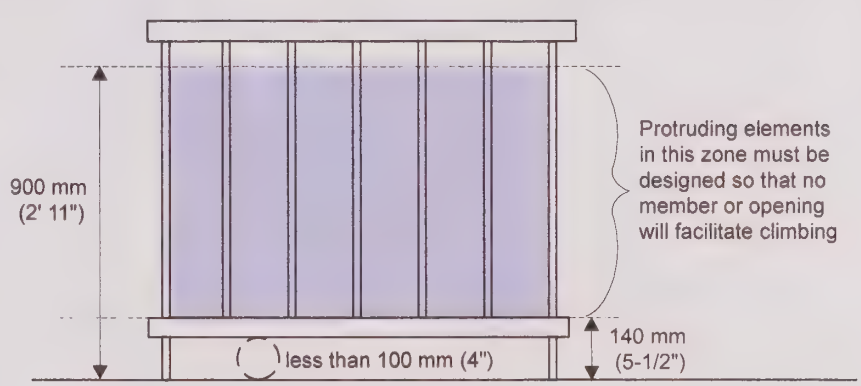
Exceptions:

1. The above requirements need not apply where the guard construction has been demonstrated to provide *effective performance*
2. Guards are in compliance if constructed in accordance with Supplementary Standard SB-7.

Figure 5.19
Load Requirements for Guard Construction (9.8.8.2.)

Guard Climbability

Guards also have restrictions to limit their ability to be climbed. As with the openings in guards, this is especially important to prevent children who may be tempted to climb the guard, exposing themselves to the risk of falling. However, the restrictions do allow for decorative guards to be used. These restrictions are outlined in 9.8.8.6, and are shown in Figure 5.20.



See Building Code Commission Hearing Ruling No. 02-03-858

Figure 5.20
Guards Designed Not to Facilitate Climbing (9.8.8.6.)

6 FIRE SAFETY AND SOUND CONTROL

This chapter is devoted to fire safety and sound control in dwelling units. More specifically, requirements are presented for detached, semi-detached and row-dwelling units. The topic of fire safety is sequenced to follow the steps essential to the design of fire control systems. Sound control provisions are presented, acknowledging that fire and sound control elements within building assemblies are often interrelated.

Fire safety is divided into four major components: fire protection, detection, containment and suppression. The first deals with the initial onset of fire and what precautions must be considered in construction to avoid it. Detection of fire outlines provisions for fire warning systems. Containment of fire discusses the required clearances and separations for controlling fire. Finally, suppression of fire relates to the Code provisions for the extinguishing of fires.

Sound control requirements of the Code are presented in the last section of this chapter.

KEY POINTS

Residential buildings must be designed and constructed to fulfill the following functions:

- prevent the outbreak of fire through good building practices;
- provide early detection and notification of fire and smoke to the occupants;
- contain the spread of fire within a dwelling unit;
- ensure that fire can be suppressed; and
- control airborne sound between dwelling units.

How Fires Work

Understanding the combustion process is essential to the safe design and construction of buildings of combustible construction.

A fire requires three elments to ignite: fuel, heat and oxygen. Removing any one element eliminates the possibility of a fire from starting.

Consider the fire that starts in a wall from an electrical short-circuit. The source of heat is the overheated wire inside the wood-frame wall assembly which comes in direct contact with the wood. The wood absorbs the heat which in turn releases the moisture in the wood as water vapour or steam.

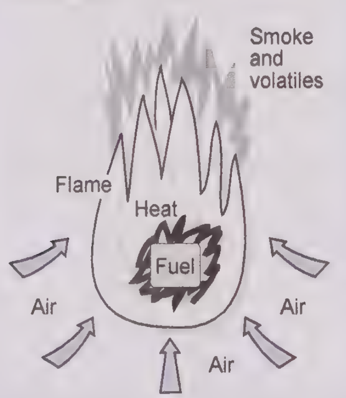
As the temperature continues to rise the wood undergoes pyrolysis; that is, it begins to decompose with the release of wood vapours or volatiles. The volatiles mix with the oxygen within the wall cavity and can ignite to produce a flame. The flame producing heat can cause more of the wood to decompose and more volatiles which feed the flame. The figure below illustrates the combustion process.

Fire can be suppressed by removing one of the required elements of combustion. Fuel is always present as part of the wood frame of the building. Of the other two elements, heat and oxygen, the heat component can be eliminated by spraying cool water onto the fire. This is possible only where the fire is accessible.

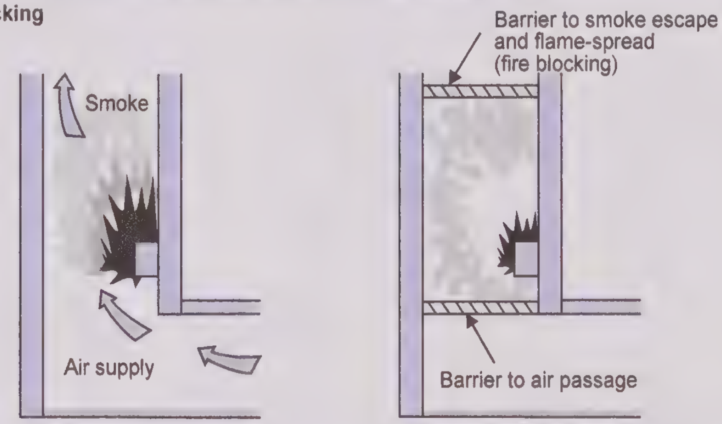
Limiting the flow of oxygen to the fire is the common approach taken to the control of fire within concealed spaces. Referred to as fire blocking, it involves the construction of building assemblies with air stops, that limit the passage of oxygen between inter-connected spaces within building assemblies.

Fire blocks delay flames in concealed spaces from passing to spaces which are connected. In wall assemblies, fire blocking must be placed at both the bottom and top of the wall to limit the feed of oxygen from the bottom and to retard the escape of smoke at the top. The figures below illustrate this process.

Combustion Process



Fire Blocking



FIRE PROTECTION

BUILDING CODE REFERENCES

DIVISION B

9.10.1.2.	Sloped Roofs
9.10.3.1.	Fire-Resistance and Fire-Protection Ratings
9.10.3.2.	Flame-Spread Rating
9.10.3.3.	Fire Exposure
9.10.7.1.	Protection of Structural Steel Members
9.10.17.1.	Flame-Spread Rating of Interior Surfaces
9.10.17.10.	Protection of Foamed Plastics
9.10.17.11.	Walls and Ceilings in Bathrooms
9.10.17.12.	Coverings or Linings of Ducts
9.10.22.1.	Installation of Ranges
9.10.22.2.	Vertical Clearances above Cooktops
9.10.22.3	Protection Around Cooktops
9.18.7.1.	Crawl Spaces as Warm Air Plenums

There are three stages through which a fire progresses. The first stage is the ignition of the fire. The second stage is combustion, where the ability of a material to burn is critical. The third stage is fire spread which depends on how quickly a material burns. The fire protection provisions of the Code are based on fire-resistance ratings for building assemblies derived from laboratory fire tests. In addition, the Code provides flame-spread ratings for the control of fire. These relate primarily to the ignition and combustion of interior finishes.

General

Exterior walls that are fire-rated must be rated from the inside of the dwelling unit as shown in Figure 6.1.

Firewalls and party walls and those fire separations inside of a dwelling unit must be rated on both sides for fire exposure.

Roofs that are sloped 60° or more from the horizontal are considered walls for fire exposure as shown in Figure 6.2.

Fire Ratings on Materials and Assemblies

Fire-resistance ratings are used for wall assemblies that are constructed as fire separations. Fire-resistance ratings are determined based on test methods that are outlined in Part 3 of the Building Code and the available evidence presented Supplementary Standard SB-2. Alternatively, wall assemblies may be chosen from Supplementary Standard SB-3 where fire-resistance ratings are assigned to the listed assemblies based on test information. Figure 6.3 shows typical wall assemblies found in SB-3 and lists the particular material components which would establish the fire-resistance rating.

The type, density and fill thickness of absorptive material required to achieve specified fire-resistance ratings are described in notes (4) and (6) to Table 1 in SB-3.

Heavy timber construction provides a 45 minute fire-resistance rating. The wood elements are to be solid without thin sections or any sharp projections. The minimum dimensions of the wood elements of arches, girders, columns, beams and trusses are presented in Article 3.1.4.6., referenced by Article 9.10.6.2. of the Code.

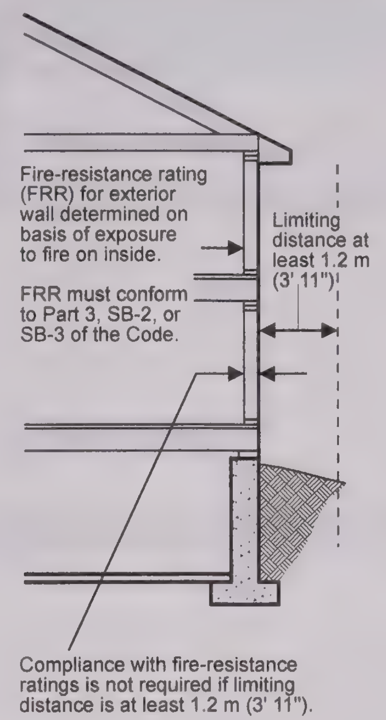


Figure 6.1
Rating Exterior Walls (9.10.3.1.) (9.10.3.3.)

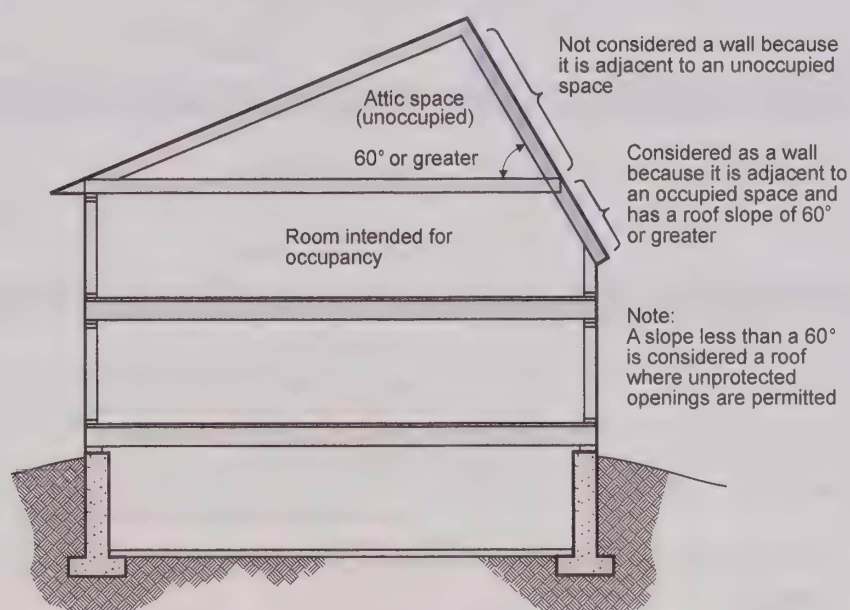
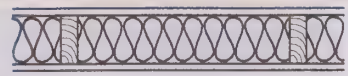
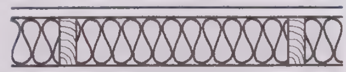
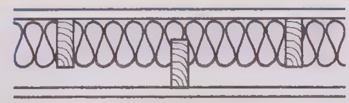
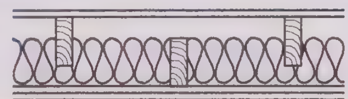
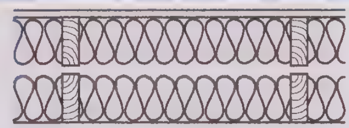
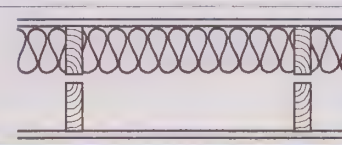
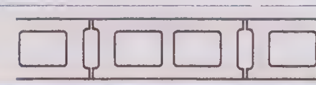
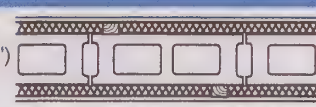
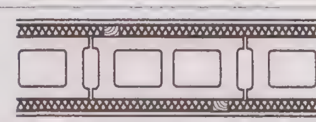


Figure 6.2
Roofs as Walls (9.10.1.2.)

Fire Resistance Rating (FRR) and Typical Sound Transmission Class (STC) of Wall Assemblies

Wall Type Code	(FRR) Loadbearing	(FRR) Non-Loadbearing	(STC)	Wall Assembly
Interior Wall Framing				
W1c	30 min	30 min	32	- 38 x 89 mm (2 x 4) studs - 1 layer 12.7 mm (1/2") gypsum board on each side - 89 mm (3-1/2") absorptive material 
W1a	1 h	1 h	36	- 38 x 89 mm (2 x 4) studs - 1 layer Type X 15.9 mm (5/8") gypsum board on each side - 89 mm (3-1/2") absorptive material 
W2f	45 min	1 h	34	- 38 x 89 mm (2 x 4) studs - no absorptive material - 2 layers 12.7 mm (1/2") gypsum board on each side 
Interior Staggered Studwall				
W8a	1 h	1.5 h	52	- 2 rows 38 x 89 mm (2 x 4) studs staggered on common 38 x 140 mm (2 x 6) plate - 1 layer of Type X 15.9 mm (5/8") gypsum board on one side and two layers of 15.9 mm (5/8") gypsum board on the other side - 89 mm (3-1/2") absorptive material on one side or 65 mm (2-1/2") thick on each side 
W8b	45 min	1 h	50	- 2 rows 38 x 89 mm (2 x 4) studs staggered on common 38 x 140 mm (2 x 6) plate - 1 layer of Type X 12.7 mm (1/2") gypsum board on one side and two layers of 12.7 mm (1/2") gypsum board on the other side - 89 mm (3-1/2") absorptive material on one side or 65 mm (2-1/2") thick on each side 
Interior Double Stud				
W13a	1 h	1 h	57	- 2 rows of 38 x 89 mm (2 x 4) studs on separate plates with a 25 mm (1") space - Type X 15.9 mm (5/8") gypsum board on each side - 89 mm (3-1/2") absorptive material on each side 
W13c	1 h	1 h	54	- 2 rows of 38 x 89 mm (2 x 4) studs on separate plates with a 25 mm (1") space - 15.9 mm (5/8") Type X gypsum board on each side - 89 mm (3-1/2") absorptive material one side only 
Hollow Concrete Block				
B1a	1 h	1 h	48	- 140 mm (6") Block - 2 coats paint each side 
B1b	1.5 h	1.5 h	50	- 190 mm (8") Block - 2 coats paint each side 
Gypsum Board on Concrete Block				
B6a	2 h	2 h	57	- 140 mm (6") Block - 12.7 mm (1/2") Type X gypsum board on each side or 15.9 mm (5/8") - absorptive material to fill strapping space each side Type X - 38 x 38 mm (2 x 2) strapping on each side 
B6d	2.5 h	2.5 h	59	- 190 mm (8") Block - 12.7 mm (1/2") Type X gypsum board on each side - 38 x 38 mm (2 x 2) strapping on each side - absorptive material to fill strapping space each side 

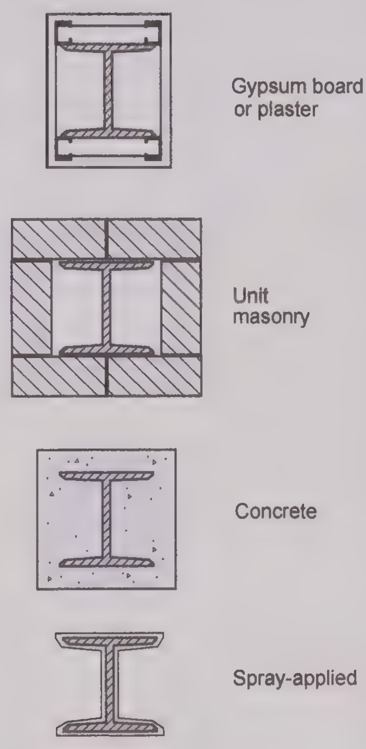
Notes to table: Refer to Supplementary Standard SB-3 of the Code for all application assumptions to the above wall assemblies.

Figure 6.3
Fire and Sound Ratings of Common Wall Assemblies (9.10.3.1.)

Protection for steel members is required for loadbearing members with the following exceptions:

- loadbearing walls may have steel lintels up to 2 m (6' 7") in length that are unprotected, and non-loadbearing walls may have steel lintels up to 3 m (9' 10") in length that are unprotected
- the bottom flanges of shelf angles that are not part of the structural steel framing need not be protected
- steel members that support stairs but are not part of any structural steel framing need not be protected.

Steel fire protection can be achieved by using gypsum board, plaster, concrete, masonry or spray-on fire protection as described by the Code (Figure 6.4).



Protection to provide fire resistance equal to fire resistance rating required for construction supported by the steel member (9.10.7.1.) (3.2.2.3.)

Figure 6.4
Protection of Structural Steel Columns

Flame-spread

Flame-spread ratings are determined based on test methods that are outlined in Part 3 of the Building Code and the available evidence presented in Section 3 of the Supplementary Standard SB-2.

Flame-spread ratings are used to regulate the selection of interior finishes to prevent the rapid spread of fire. The standard test method includes smoke development classifications that can be applied to finishes.

Flame-spread ratings assigned to materials are derived from a standard test. The rating is determined as the time versus the distance that a flame spreads across a material. Select red oak flooring is assigned a value of 100 and it takes 5.5 minutes for flames to travel 6 m (19' 6"). Asbestos cement board on the other hand is assigned a value of 0 because it does not burn. Other materials are assigned values based on this scale.

Supplementary Standard SB-2 states that wood, regardless of species, has a flame-spread rating of 150 as a simplification.

With few exceptions, flame-spread ratings apply to materials considering both the exposed surface and the edge exposure unless reference is made to surface flame-spread rating only. Interior surfaces, including glazing and skylights, that are exposed must have a flame-spread rating of not more than 150. Doors are not subject to this limitation. The interior finish of bathroom walls and ceilings are allowed a maximum flame-spread rating of 200.

Part 6 of the Building Code regulates the flame-spread ratings for duct coverings and linings. Article 6.2.3.4. of the Building Code requires that materials exposed to the surface of ducting must be noncombustible where the surface temperature may exceed 120 °C (248 °F). Where these materials are allowed to be combustible, they must have a flame-spread rating of 25 or less and smoke classification ratings of 50 or less. The outer covering on air duct systems in combustible construction must have a flame-spread rating of 75 or less and a smoke development classification rating of 50 or less.

Fire Protection for Foamed Plastics

Foamed plastics generally do not meet the flame-spread rating required of interior finishes and therefore require protection when part of a wall or ceiling assembly in any finished or unfinished space. This protection may be plaster, gypsum board, plywood finishing, hardboard, insulating fibreboard, particleboard waferboard or OSB. Chapter 14 has more information on these materials.

Looking Ahead

Fire protection for fireplaces can prevent a controlled fire from becoming an uncontrolled one. The clearance of a fireplace to combustible framing must conform to the requirements of Chapter 10: Fireplaces, Chimneys, and Flues.

It is very important that the exposure of combustible material is kept at a safe distance from the opening of a fireplace. Chapter 10 provides details.

Refer to Chapter 13 for more information on the protection of foamed plastics.

Fire Protection for Gas, Propane & Electric Cooktops

The use of gas, propane and electric cooktops requires that adjacent framing, finishes and cabinetry be protected. A vertical clearance of 750 mm (2' 6") or greater must be provided between the elements or burners of the cooktop, and materials which are located directly above. This clearance may be reduced to 600 mm (23-5/8") where the framing, finishes and cabinets above the cooktop are noncombustible, protected with 6 mm (1/4") thick asbestos millboard, protected with 0.33 mm (0.013") thick sheet metal, or protected by a metal range hood that projects at least 125 mm (4-7/8") out in front of the framing, finishes and cabinets.

Any combustible wall framing, cabinets or finishes (except counter-top splash boards or back plates) that is located within 450 mm (17-3/4") of either side of the cooktop must be protected above the level of the cooktop burners or elements by a material with a fire-resistance equal to or greater than that of 9.5 mm (3/8") gypsum board. Cabinets located more than 450 mm (17-3/4") above the level of the elements or burners are exempt from this requirement. Figure 6.5 illustrates the requirements for fire protection set out in Subsection 9.10.22.

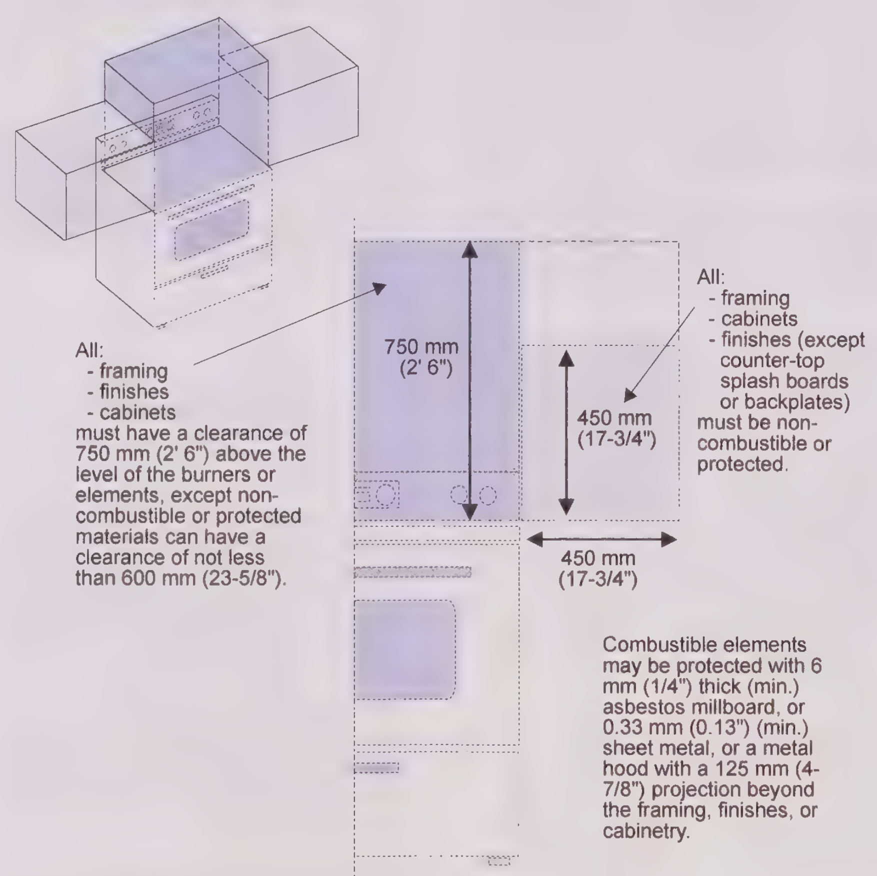


Figure 6.5
Clearances for Gas, Propane, and Electric Cooktops (9.10.22.)

Fire Protection for Crawl Spaces Used as Warm Air Plenums

Crawl spaces used as warm air plenums can have only one storey above them, and all enclosing material including insulation must not have a surface flame-spread rating above 150. A combustible ground cover must be covered with a noncombustible surface.

DETECTION OF FIRE

BUILDING CODE REFERENCES

DIVISION B

9.10.19.1. Required Smoke Alarms
9.10.19.2. Sound Patterns of Smoke Alarms
9.10.19.3. Location of Smoke Alarms
9.10.19.4. Power Supply
9.10.19.5. Interconnection of Smoke Alarms
9.10.19.6. Silencing of Smoke Alarms
9.10.19.7. Instructions for Maintenance and Care

In a dwelling unit, the detection of fire is normally provided using smoke alarms.

SMOKE ALARMS

Smoke alarms conforming to CAN/ULC-S531, "Smoke Alarms" must be provided inside of each dwelling unit to detect smoke from a fire and warn the occupants with an audible alarm.

Smoke alarms must be placed on every storey, including basements, preferably near stairs connecting floor levels. Storeys with bedrooms must have smoke alarms installed in each bedroom and in a location between all of the bedrooms and the remaining sections of storey. A hallway or other central space between the bedrooms is generally a suitable smoke alarm location; however, locations near kitchens and bathrooms should be avoided as normal kitchen odours and humidity may create nuisance alarms. Alarms must be installed on or near the ceiling and in conformance with CAN/ULC-S553, "Installation of Smoke Alarms". Sounds patterns must meet the temporal patters of alarm signals, or a combination of temporal pattern and voice relay.

Smoke alarms must be powered with a direct permanent electrical line that has no switches which can render the device inoperable. Smoke alarms must also be provided with a battery back-up that can last 7 days in case of power interruption, followed by 4 minutes of alarm. A manually operated device is permitted to be incorporated within the circuitry of a smoke alarm that will silence the signal for a period of not more than 10 minutes, after which the smoke alarm will reset and sound again if there is sufficient smoke present to reactuate it. If the building is not supplied with electrical power, batteries may be used for operation.

Smoke alarms must be interconnected when more than one of them is required in the dwelling unit so that when one is activated, all alarms sound.

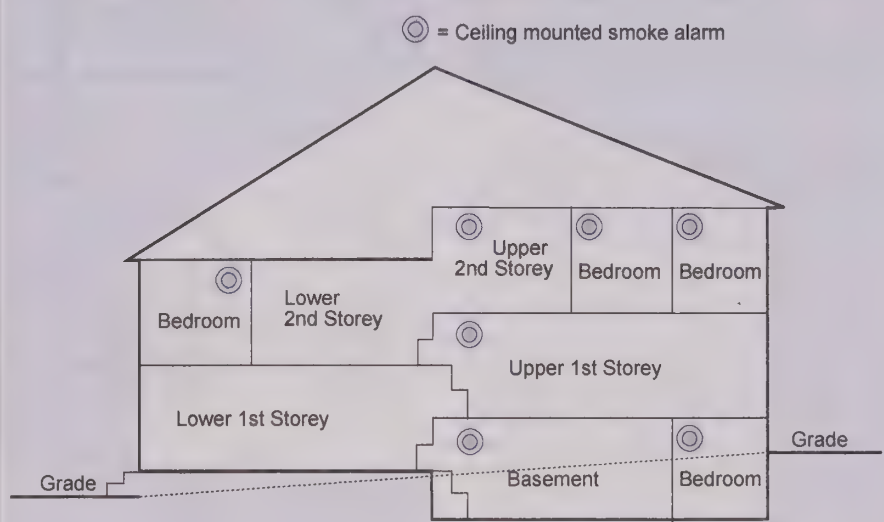
Occupants of a dwelling unit must be able to easily refer to the maintenance and care of smoke alarms in a place which is suitable for posting such information.

On January 1, 2015, smoke alarms will be required to produce visual signalling in addition to the auditory signalling. The visual signalling must conform to the light, colour, and pulse requirements of the NFPA 72, "National Fire Alarm and Signaling Code" or ULC S526, "Visual Signal Devices for Fire Alarms, Including Accessories".

Looking Ahead

Consider the installation of carbon monoxide alarms.

Smoke Alarms for Split Level-Walkup



Refer to manufacturer's installation instructions

CONTAINMENT OF FIRE

BUILDING CODE REFERENCES

DIVISION B

- 3.1.9.1. Fire Stops
- 9.9.4.6. Openings Near Exit Doors
- 9.10.5.1. Permitted Openings in Wall and Ceiling Membranes
- 9.10.9.2. Continuous Barrier
- 9.10.9.3. Openings to be Protected With Closures
- 9.10.9.6. Penetration of Fire Separations
- 9.10.9.7. Combustible Piping
- 9.10.9.8. Collapse of Combustible Construction
- 9.10.9.9. Reduction in Thickness of Fire Separation by Beams and Joists
- 9.10.9.10. Concealed Spaces Above Fire Separations
- 9.10.9.14. Separation of Residential Suites
- 9.10.9.16. Separation of Storage Garages
- 9.10.11.1. Required Firewalls
- 9.10.11.2. Firewalls Not Required
- 9.10.11.3. Construction of Firewalls
- 9.10.11.4. Firewalls in Detached Garages
- 9.10.12.2. Location of Skylights
- 9.10.12.3. Exterior Walls Meeting at an Angle
- 9.10.12.4. Protection of Soffits
- 9.10.13.5. Wired Glass as a Closure
- 9.10.13.7. Glass Block as a Closure
- 9.10.13.15. Doors Between Garages and Dwelling Units
- 9.10.15. Spatial Separation Between Houses
- 9.10.15.1. Application
- 9.10.15.2. Area and Location of Exposing Building Face
- 9.10.15.3. Inadequate Firefighting Facilities
- 9.10.15.4. Glazed Openings in Exposing Building Face
- 9.10.15.5. Construction of Exposing Building Face of Houses
- 9.10.16.1. Required Fire Blocks in Concealed Spaces
- 9.10.16.2. Required Fire Blocks in Wall Assemblies
- 9.10.16.3. Fire Block Materials
- 9.10.16.4. Penetration of Fire Blocks

The fire and spatial separation requirements of the Code are designed to limit or impede the spread of fire from one dwelling unit to another. These are detailed in the following sections.

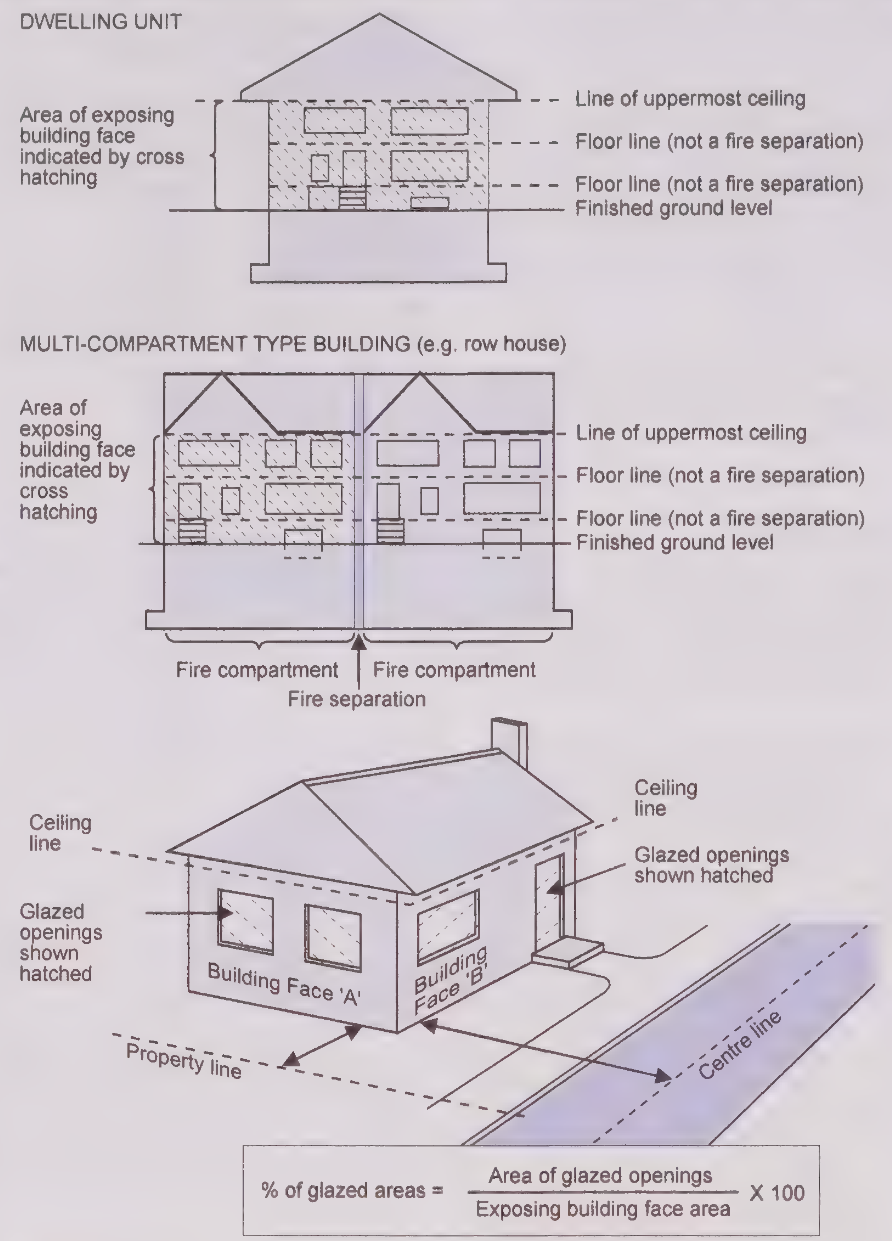
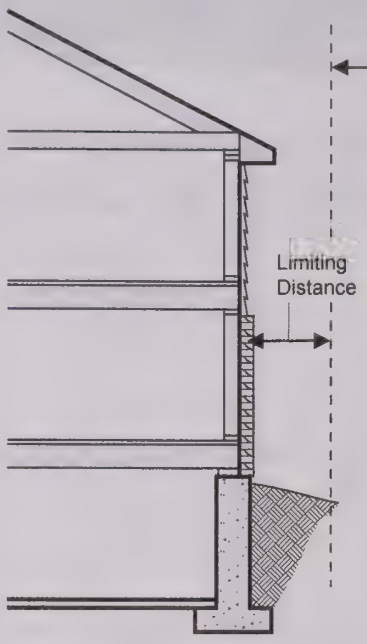


Figure 6.6
Determining Area of an Exposing Building Face (9.10.15.2.)

Spatial Separation Between Dwelling Units

The exposing building face of a dwelling unit is the area established by the building width, grade and the height of the uppermost ceiling. Where there are fire separations to create fire compartments, these compartments may be calculated as separate exposing building faces, as long as those fire separations have a fire-resistance rating of at least 45 minutes. Figure 6.6 illustrates the method of determining the area of an exposing building face.



Limiting Distance	Fire-Resistance Rating	Non-combustible Cladding	Glazed Openings
less than 0.6 m (23-5/8")	45 min	Required	Not permitted
0.6 m (23-5/8") or greater but less than 1.2 m (3' 11")	45 min	Not required	Not permitted
1.2 m (3' 11") or greater	Not required	Not required	As in Figure 6.9

Figure 6.7
Rating Exterior Walls (9.10.15.5.(2))

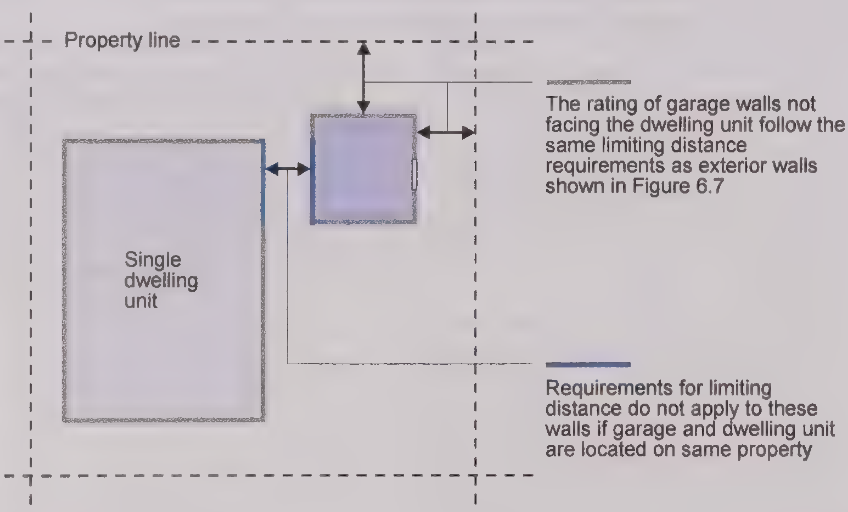


Figure 6.8
Fire Rating for a Detached Garage Serving One Dwelling Unit (9.10.15.4.(3)) (9.10.15.5.(4))

The exposing building face of a dwelling unit must have at least a 45 minute fire-resistance rating when the limiting distance is less than 1.2 m (3' 11"). If the limiting distance is less than 0.6 m (23-5/8"), the exposing face of the dwelling unit must have a noncombustible cladding. Figure 6.7 shows these requirements.

Cladding on the exposing building face and on exterior walls located above the exposing building face that enclose an attic or roof space need not be noncombustible when the limiting distance is less than 0.6 m (23-5/8") provided it meets the Code requirements for this application: the cladding must conform to Subsection 9.27.13., be no greater than 2 mm (3/32") thick, be installed without furring members over masonry or not greater than 12.7 mm (1/2") thick gypsum sheathing, and have a flame spread rating not greater than 25.

The exposing building faces of a dwelling unit and a detached garage that face each other do not need to comply with any of the requirements if the detached garage serves the dwelling unit only and is located on the same property. (see Figure 6.8).

Buildings under 10 m² (107 ft²) (like sheds), while not governed by the Building Code, must still conform to the planning requirements (e.g. setbacks and lot coverage) of the municipality.

Glazed areas of doors, glass sliding doors and windows in the building face are considered as glazed openings in Subsection 9.10.15. of the Building Code. The area of glazed openings allowed on an exposing building face is based on the total area of the exposing building face, the distance from property lines, streets, and other buildings on the same property.

Maximum Aggregate Area of Glazed Openings, % of Exposing Building Face Area														
Maximum Area of Exposing Building Face, m² (ft²)	**Limiting Distance** m (ft-in)													
	Less than 1.2 m (3' 11")	1.2 m (3' 11")	1.5 m (4' 11")	2 m (6' 7")	2.5 m (8' 4")	3 m (9' 10")	4 m (13' 1")	6 m (19' 8")	8 m (26' 3")	10 m (32' 10")	12 m (39' 4")	16 m (54' 6")	20 m (65' 7")	25 m (82')
10 (107)	0	8	12	21	33	55	96	100	-	-	-	-	-	-
15 (160)	0	8	10	17	25	37	67	100	-	-	-	-	-	-
20 (215)	0	8	10	15	21	30	53	100	-	-	-	-	-	-
25 (267)	0	8	9	13	19	26	45	100	-	-	-	-	-	-
30 (323)	0	7	9	12	17	23	39	88	100	-	-	-	-	-
40 (431)	0	7	8	11	15	20	32	69	100	-	-	-	-	-
50 (538)	0	7	8	10	14	18	28	57	100	-	-	-	-	-
100 (1080)	0	7	8	9	11	13	18	34	56	84	100	-	-	-
Over 100 (1080)	0	7	7	8	9	10	12	19	28	40	55	92	100	-

Figure 6.9
Maximum Percentage of Glazed Openings in Exterior Walls (9.10.15.4.(1))

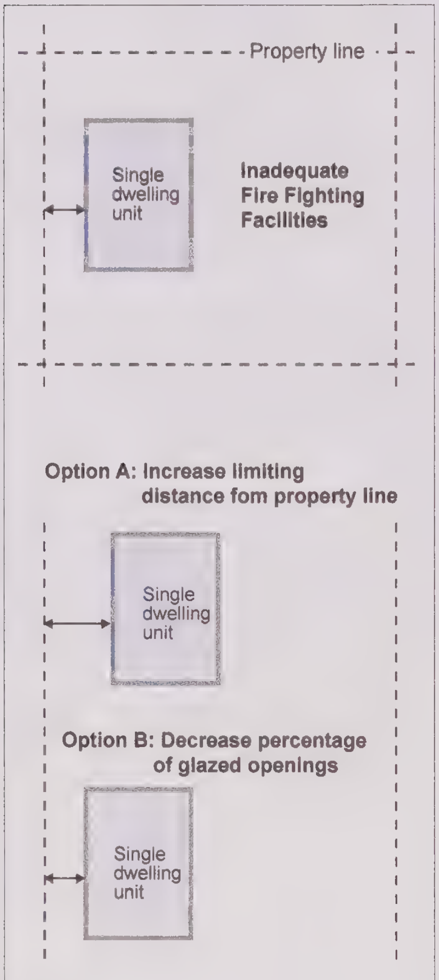


Figure 6.10
Option for Inadequate Fire Fighting Facilities (9.10.15.3.)

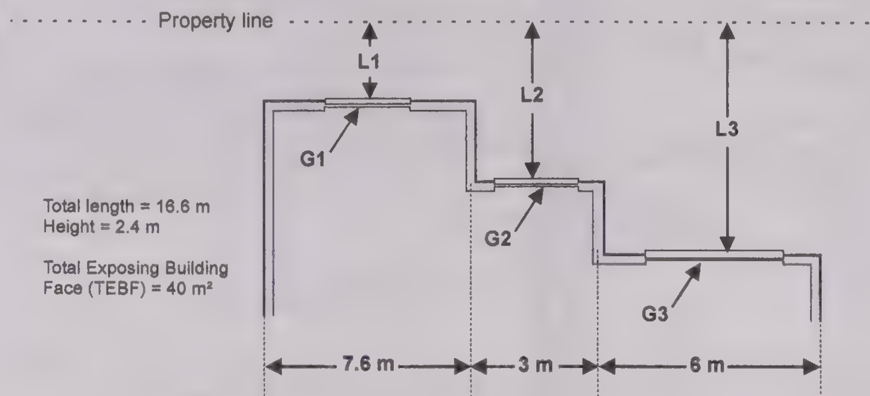
The distance from an exposing building face to a property line is referred to as the limiting distance. The limiting distance to an exposing building face establishes the maximum allowed area of glazing or alternatively unprotected openings. Figure 6.9 shows the maximum percentage of glazed openings permitted on an exposing building face.

The limiting distance as determined above must be doubled where the fire fighting facilities are deemed inadequate or the building is not sprinklered (see Figure 6.10).

The calculation of the permitted percentage of glazed area for irregularly shaped buildings can be based on different limiting distances as they might apply to different portions of the building. In other words, buildings that have a number of limiting distances can have glazing areas that are calculated based on their corresponding limiting distance rather than on just one distance. The permitted glazed area established for a portion of an exposing building face cannot be installed in any other portion of the exposed building face. Refer to Figure 6.11. See the end of the chapter for a worked example.

Exterior walls of separate dwelling units that meet at an angle of less than 135° are required to have at least 1.2 m (3' 11") between any openings, and have that portion of the wall rated as shown in Figure 6.12.

Combustible projections on row housing such as balconies, canopies, eave projections and stairs that are at least 1000 mm (3' 3") above grade must be at least 1.2 m (3' 11") from the property line or the centreline of a public laneway. Combustible projections cannot be within 2.4 m (7' 10") of each other when situated on separate buildings.



Permitted % of glazed openings **(P)**	0%	7%	11%
Permitted area of glazed openings **(G)**	not permitted	3 x 2.4 x 0.07 = 0.50 m²	6 x 2.4 x 0.11 - 1.58 m²

A1, A2 and A3 are exposing building face areas used for the calculation of permitted glazed openings

L1, L2 and L3 are limiting distances that can be applied to different portions of the same exposing building face

P1, P2 and P3 are permitted maximum glazed opening percentages based on the total area (found in Figure 6.9)

G1, G2 and G3 are the maximum percentage of permitted glazed area for that portion

Example:
Calculate the permitted area of glazing given the limiting distances and exposing building face area for the irregularly shaped building as noted below:

L1 = 0.4 m	A1 = 3 x 2.4 = 7.2 m²
L2 = 1.2 m	A2 = 7.6 x 2.4 = 18.2 m²
L3 = 2.0 m	A3 = 6 x 2.4 = 14.4 m²

Calculate the TEBF to determine the percentage of glazing area permitted for that portion using Figure 6.9

TEBF = Total length x Height
= 16.6 x 2.4 = 40 m²

P1 = 0%
P2 = 7%
P3 = 11%

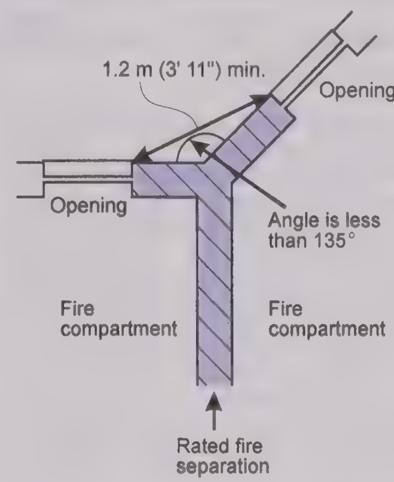
From the figure above the maximum percentage of permitted glazed area for each portion of the exposing building area would be:

G1 = A1 x 0% = 0 m²
G2 = A2 x 7% = 0.50 m²
G3 = A3 x 11% = 1.58 m²

Note: This same procedure can be used to calculate required fire-resistance ratings. The permitted area established for a portion of exposing building face cannot be installed in any other portion of exposing building face (i.e. G1 can only be located in A1, etc...).

See the end of the chapter for another example

Figure 6.11
Determining Percentage of Permitted Glazed Openings for Irregular Shaped Buildings (9.10.15.5.)



Exterior wall must have same fire resistance rating as the fire separation that divides the two fire compartments when angle between exterior walls is less than 135˚

- - - - -	Interior Fire Separation
d	1.2 m (3' 11") minimum

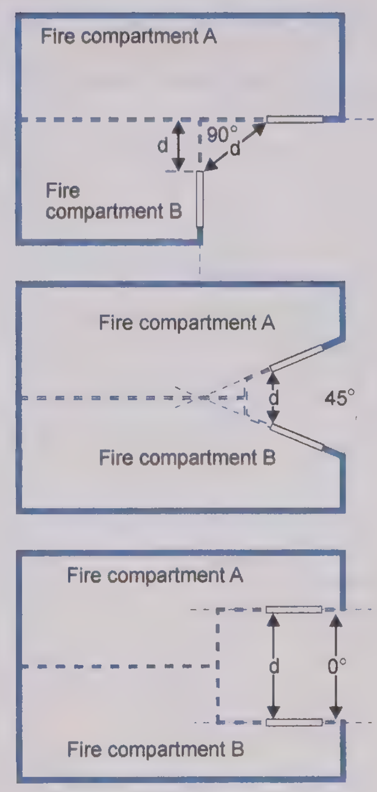


Figure 6.12
Ratings and Openings in Angled Exterior Walls (9.10.12.3.)

Firewalls, Party Walls and Fire Separations

Firewalls are a special type of fire separation which subdivide a building or create separate adjoining buildings to resist the spread of fire. Firewalls must be made of noncombustible material for fire-resistance ratings more than 2 hours. They must have the fire-resistance ratings as prescribed by the Code and are designed to have enough structural stability to remain intact under fire conditions for the rated period of time. Refer to Figure 6.13. The ends of a firewall must be continuous to the edge and the top of the building. Figure 6.14 shows that a combustible material cannot extend across the end of the firewall.

Fire separations are assemblies constructed to act as continuous barriers to fire. These may or may not have fire ratings. Fire separations can be constructed with combustible materials. Refer to Subsections 9.10.10. and 9.10.11. of the Code for additional information.

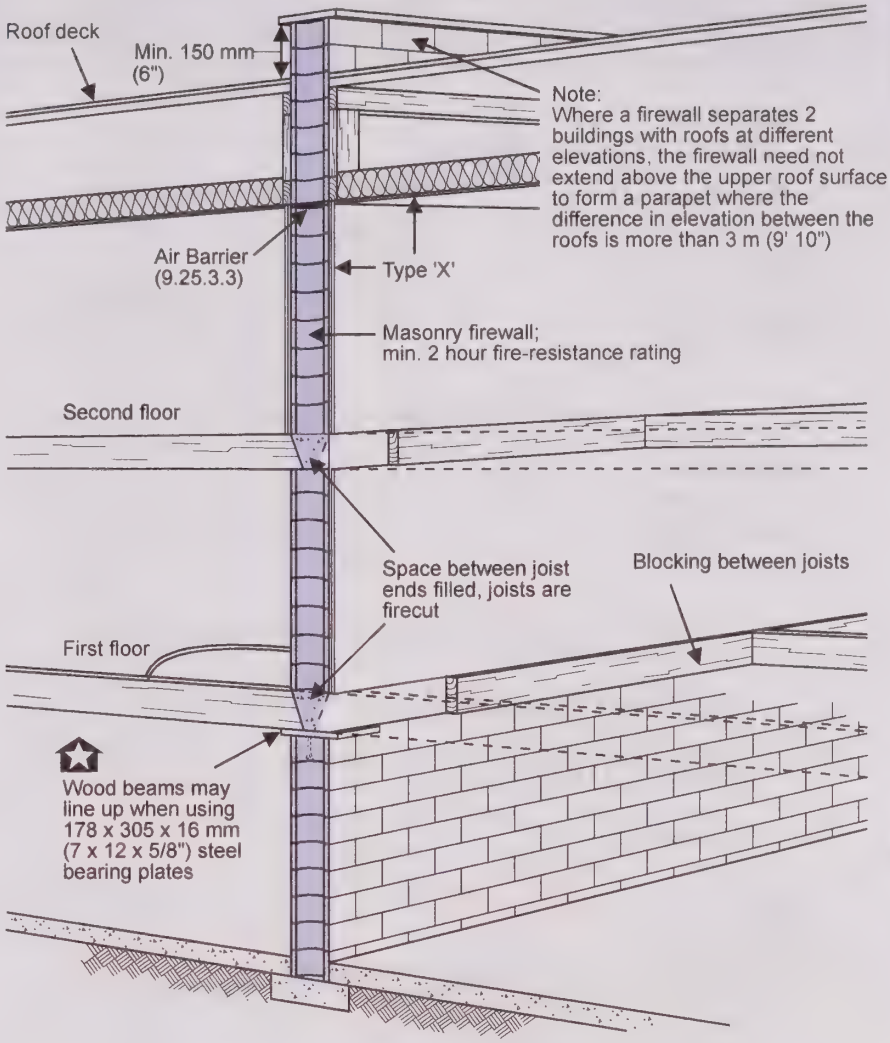


Figure 6.13
FireWall Construction (9.10.11.3.)

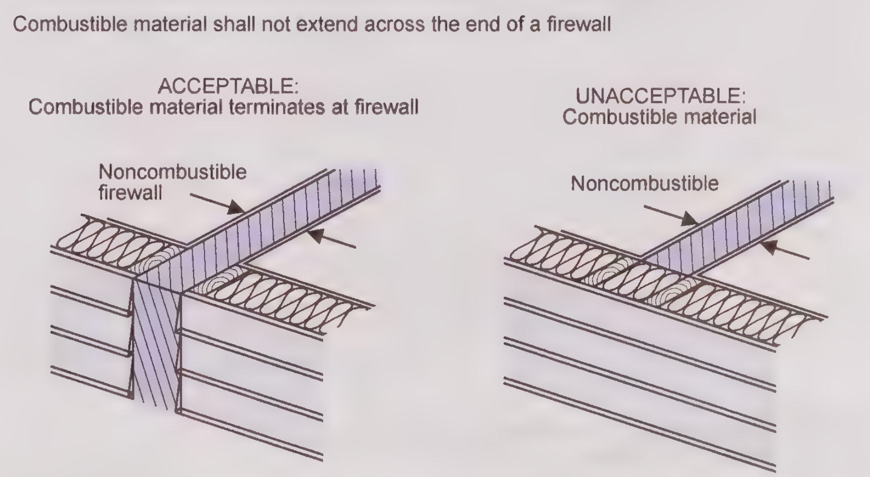


Figure 6.14
End of Fire Walls (9.10.11.3.)

Party walls on property lines that separate dwelling units need not be constructed as firewalls. However, they must be constructed as fire separations with a minimum 1 hour fire-resistance rating. Figure 6.15 illustrates the essential differences between party walls (fire separations) and firewalls. Party walls must be continuous from the top of the footings to the underside of the roof sheathing as shown in Figure 6.16 and 6.17. It is very important that there is a complete seal with a noncombustible material between the top of the wall and the underside of the roof sheathing to reduce the likelihood that smoke or flame will pass across the fire separation. Refer to Figures 6.18 - 6.21.

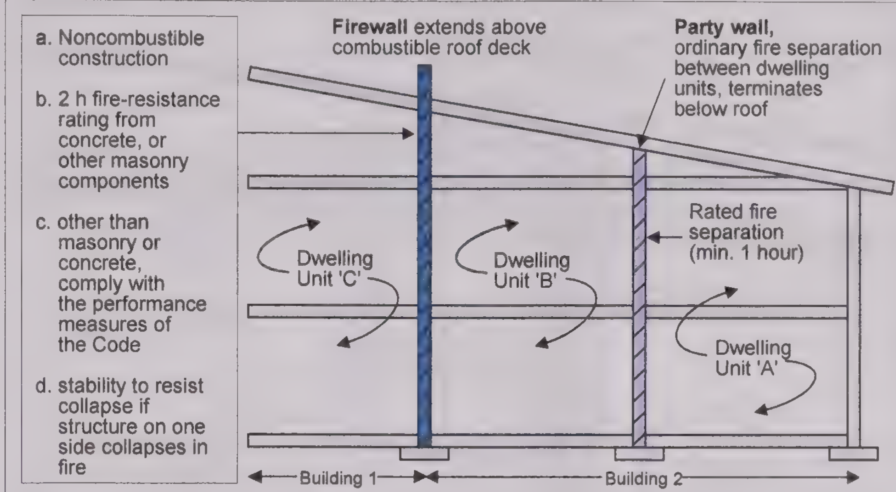


Figure 6.15
Fire Walls and Party Walls Between Dwelling Units (3.1.10.2.) (9.10.11.2.)

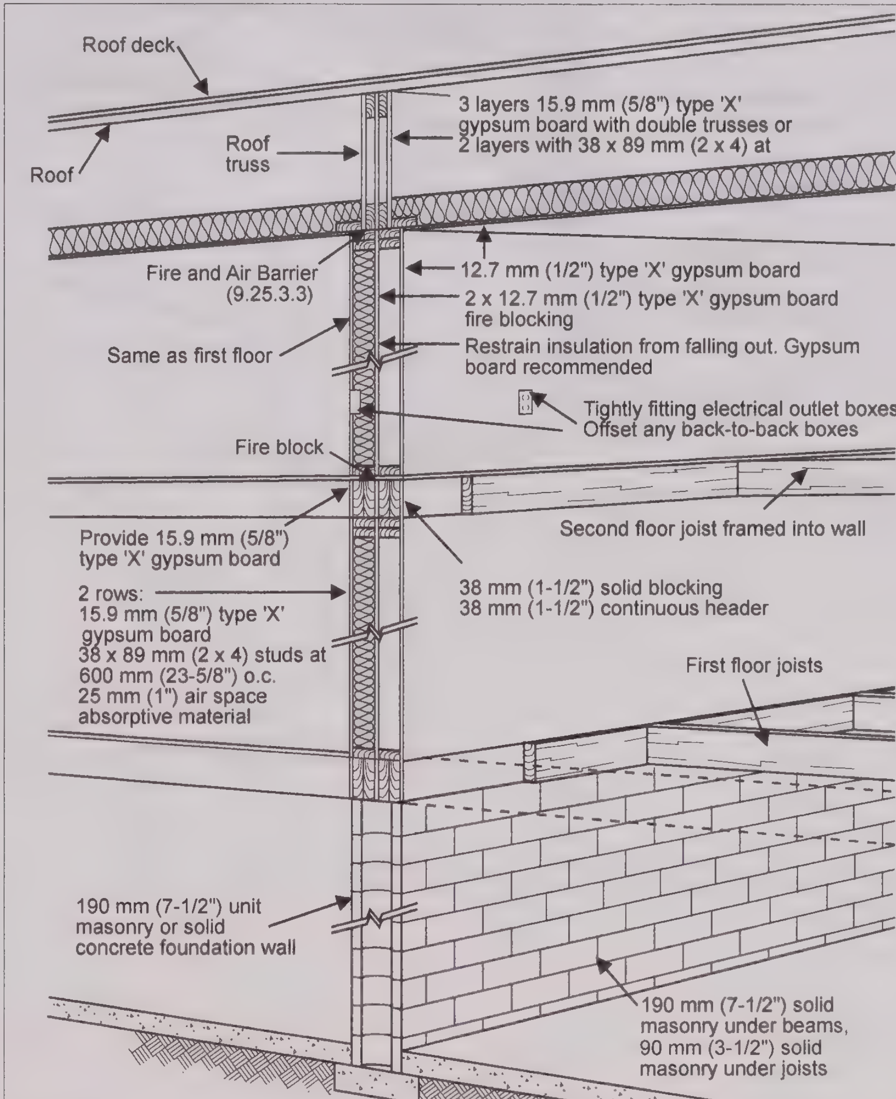


Figure 6.16
Framed Party Wall Construction as Fire Separation (9.10.11.3.)

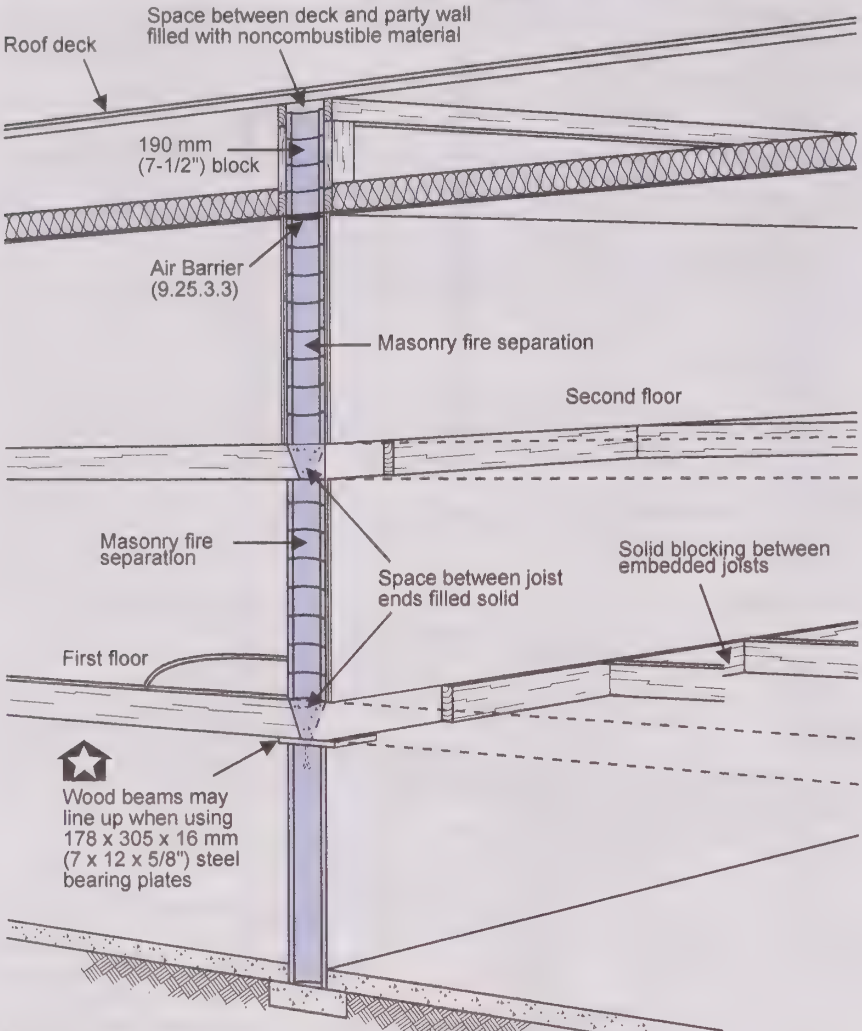


Figure 6.17
Masonry Party Wall as Fire Separation (9.10.11.3.)

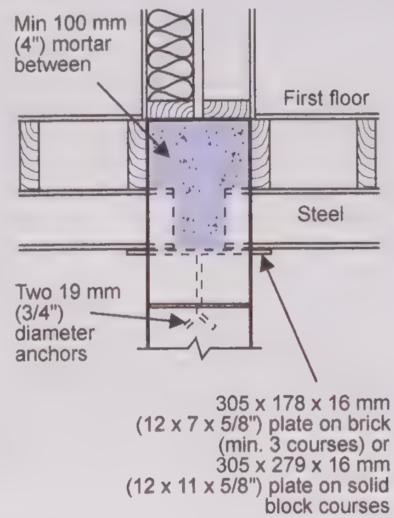


Figure 6.18
First Floor Connection (9.10.11.3.)

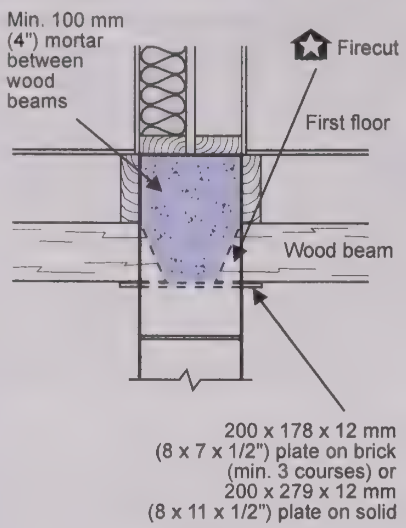


Figure 6.19
First Floor Connection Alternative 2 (9.10.11.3.)

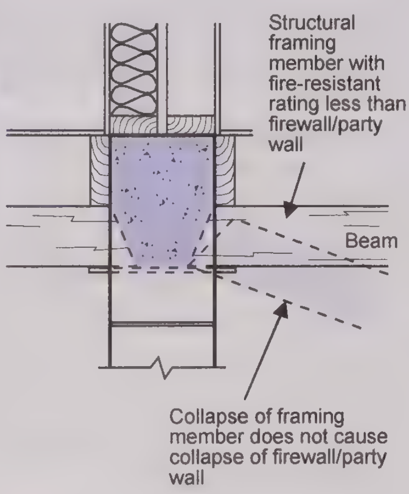


Figure 6.22
Function of Firecut (9.10.9.8.)

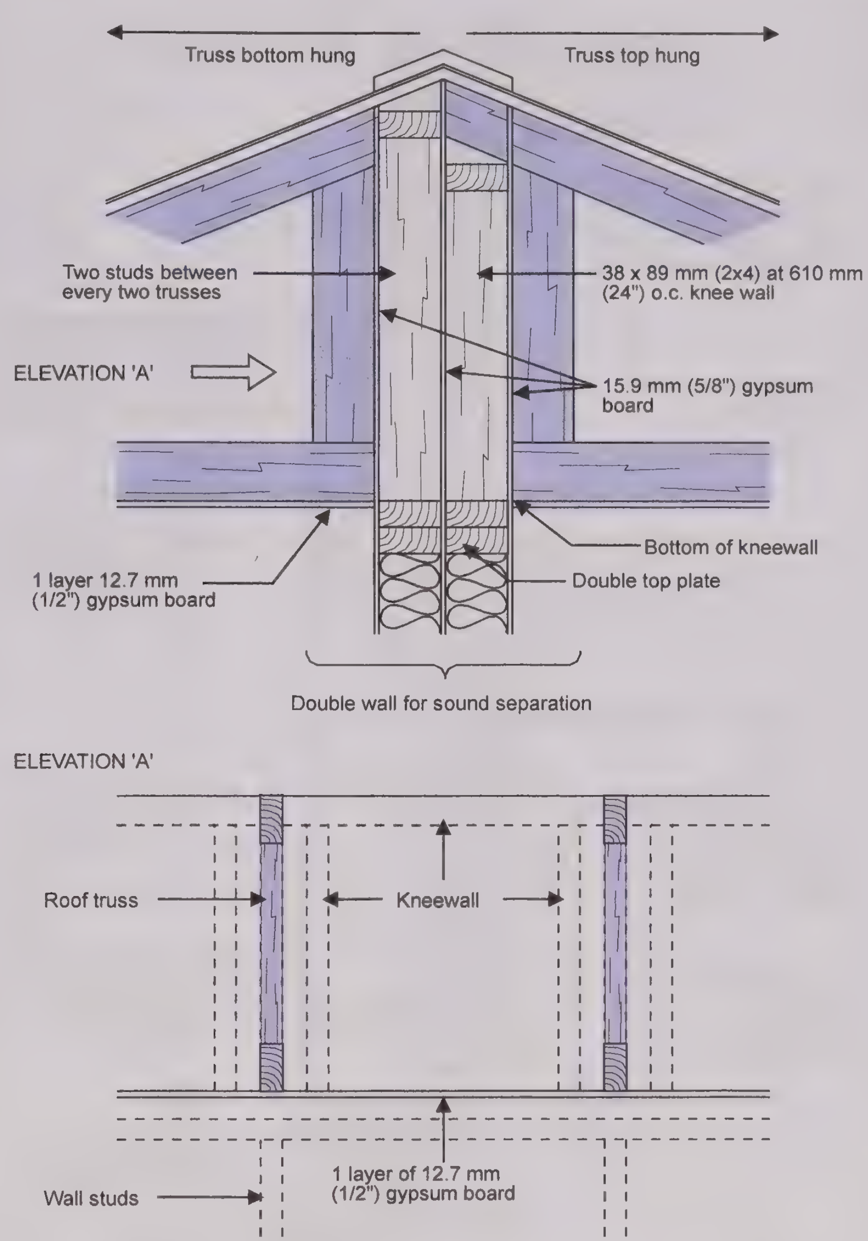


Figure 6.20
Roof Truss Kneewall Detail as Fire Separation (9.10.11.3.)

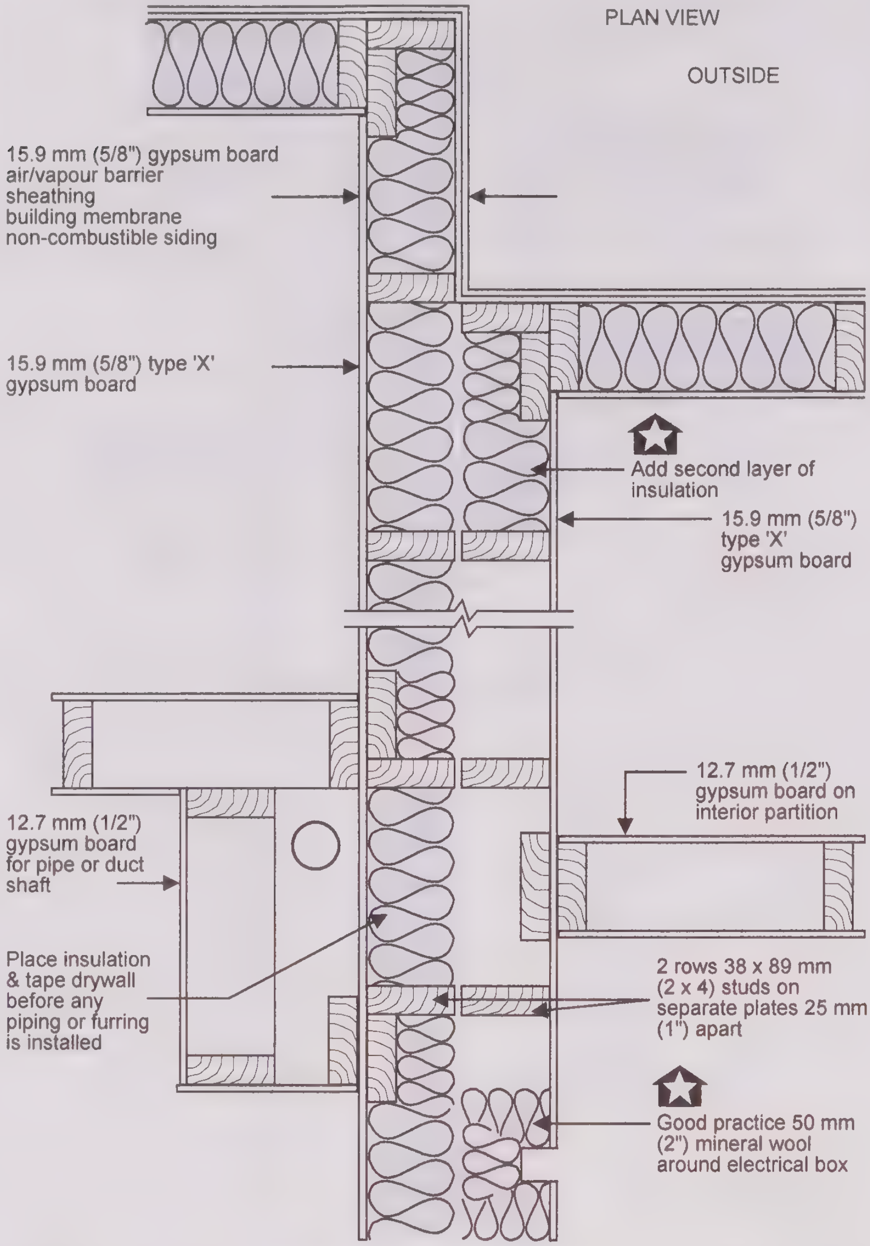


Figure 6.21
Plan of Party Wall as Fire Separation (9.10.11.3.)

Combustible construction that is supported by a firewall or party wall made of noncombustible construction must be built to collapse under fire conditions without causing the collapse of the fire separation. See Figure 6.22 on the previous page. Beams and joists framed into a masonry or concrete fire separation must not reduce the thickness of the fire separation to less than the equivalent thickness for type S monolithic concrete determined in the Supplementary Standards SB-2 for the required fire-resistance rating. Figure 6.23 illustrates this requirement.

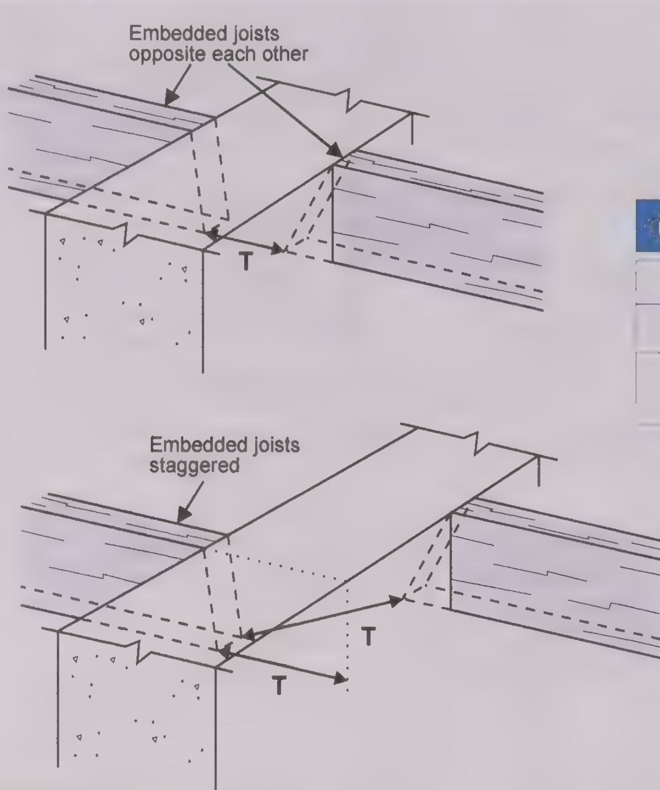
The exterior wall must have the same fire-resistance rating as the interior fire separation that divides the two fire compartments, when the angle of the wall is less than 135°. See previous Figure 6.12 for examples.

Approved noncombustible siding cladding assembly is required.

A detached garage that serves more than one dwelling unit and is split by a property line requires a fire separation of party wall construction with a fire-resistance rating of at least 45 minutes.

An attached garage which serves a single dwelling unit need not be fire separated from the dwelling unit. In this case a Code compliant air barrier system with all joints sealed and structurally supported must be installed in the separating wall to effectively prevent the diffusion of gas and exhaust fumes into the dwelling unit. In addition every door between the dwelling unit and the garage must be tight fitting, weather-stripped and equipped with a self-closing device.

To reduce the possibility that fire will travel into an attic and across to another dwelling unit or across fire separations as shown in Figure 6.24, soffits must be protected where fire blocking and sprinklers are not provided.



Minimum Equivalent Thickness of Type S Monolithic Concrete				
Required Fire-Resistance Rating				
30 min	45 min	1 h	1.5 h	2 h
60 (2-1/2")	77 (3")	90 (3-1/2")	112 (4-1/2")	130 (5")

Where pockets for the support of beams or joists are formed in a masonry or concrete fire separation, the remaining total thickness (T) must not be reduced less than what is required to maintain the required fire resistance rating. See Supplementary Standard SB-2.

Figure 6.23
Embedded Joists (9.10.9.9.)

Row housing, where fire blocking does not occur between soffits and attics, requires that the soffit within 2.5 m (8' 2") vertically and 1.2 m (3' 11") horizontally of a window or door be protected with the materials above (acceptable materials for this protection is described in the text).

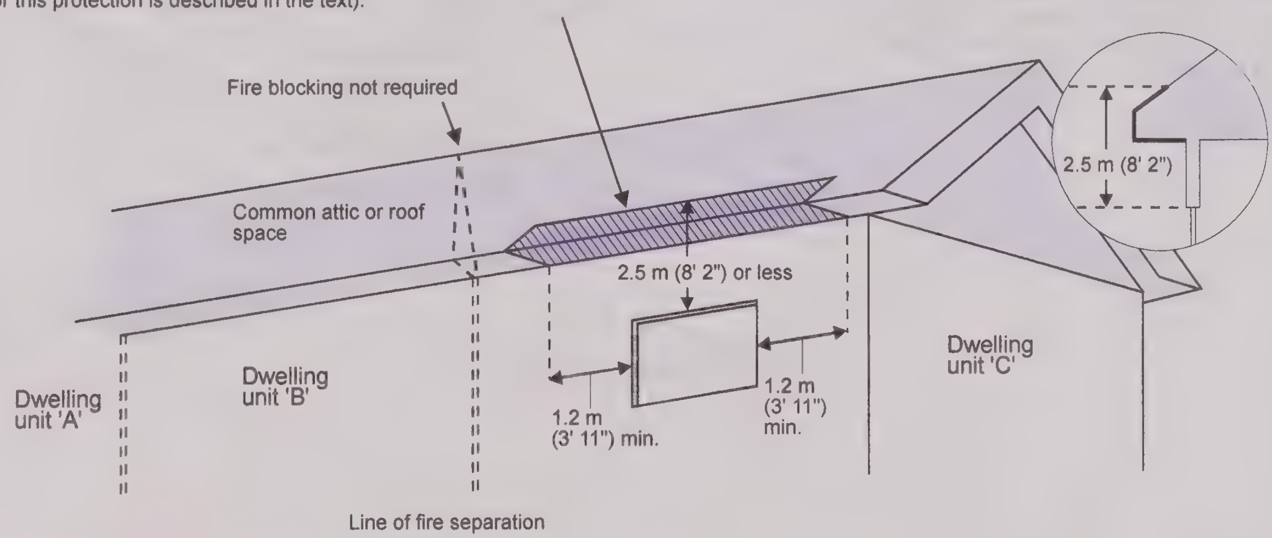


Figure 6.24
Soffit Considerations (9.10.12.4.)

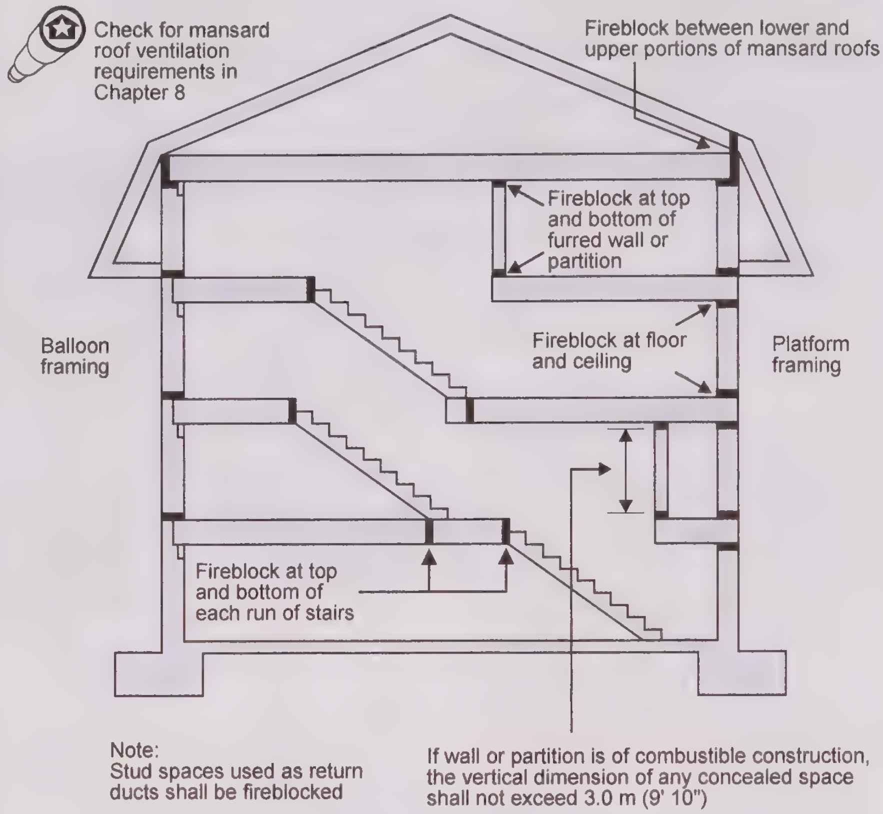
Fire Blocks

The intent of fire blocking is to limit the spread of fire in building assemblies and concealed spaces. The function of fire blocking is to cut off a fire by not allowing it to breathe (i.e. receive oxygen). Sealing concealed spaces in wall and ceiling assemblies as well as attics and crawl spaces achieves this requirement. Figure 6.25 shows the typical places that fire blocking is required in a dwelling unit.

It is important to understand that flame-spread ratings play a role in the design of fire blocks. Fire blocking must be provided at all intersections of vertical and horizontal spaces in building assemblies where flame-spread ratings of the assembly exceed 25, as shown in Figure 6.25. This does not include wiring, piping or other such services that may be within the building assembly.

Conventional wood-frame assemblies must be fire blocked since, in general, wood elements have a flamespread rating in excess of the maximum 25. Steel framing with a flamespread rating of less than 25 does not require fire blocking.

Materials for fire blocking include 0.38 mm (1/80") sheet steel, 12.7 mm (1/2") gypsum wallboard, 12.5 mm (1/2") plywood, OSB, or waferboard, 2 layers of 19 mm (3/4") lumber with staggered joints, or 38 mm (1-1/2") lumber.



Fireblock Materials
0.38 mm (1/80") sheet steel
12.7 mm (1/2") gypsum wallboard
12.5 mm (1/2") plywood OSB or waferboard
2 layers of 19 mm (3/4") lumber with staggered joints
38 mm (1-1/2") lumber
(9.10.16.3.)

Figure 6.25
Fireblock Locations and Materials
(9.10.16.1.)
(9.10.16.2.)

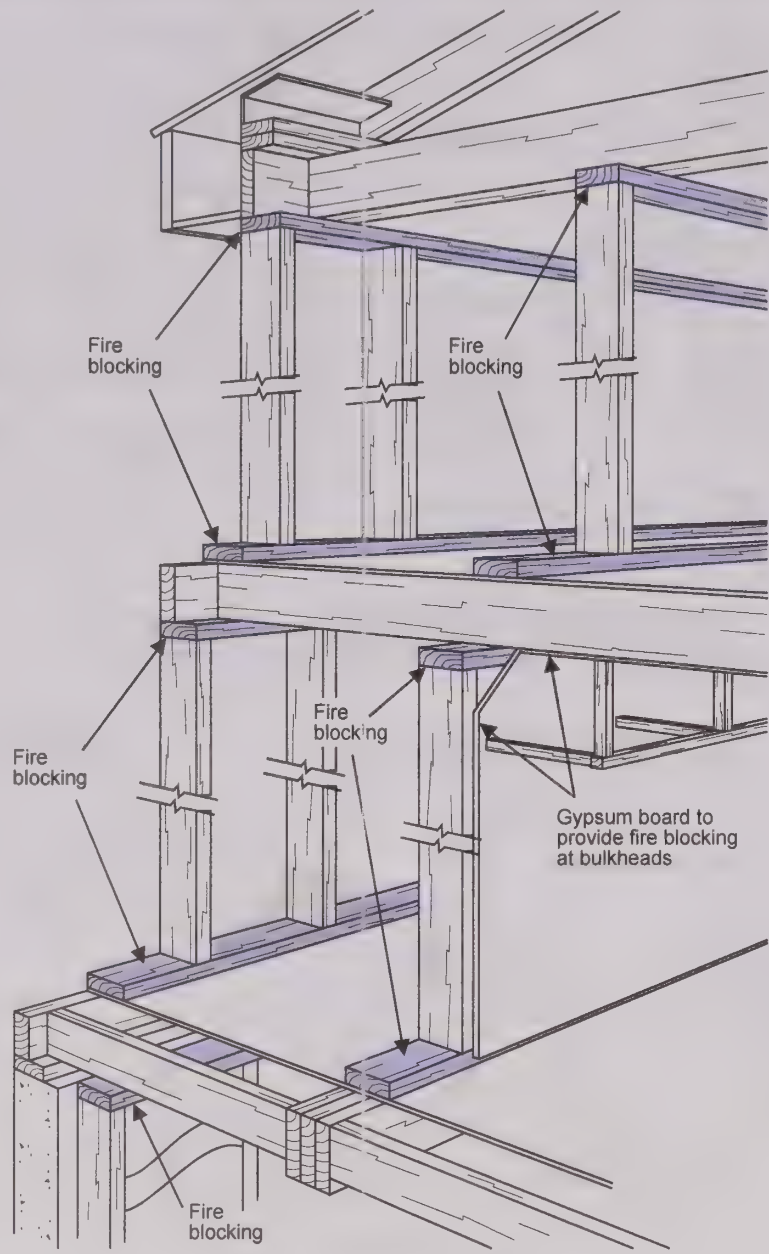


Figure 6.26
Wood Framing as Fire Blocking (9.10.16.2.)

Wall assemblies that have spaces created by furring and spaces between the studs require fire blocks every 3 m (9' 10") vertically and every 20 m (65' 7") horizontally. Note that a standard wood frame wall has built-in fire blocks, the sole plate and the top plate as shown in Figure 6.26. Special header details with coved ceilings may require fire blocking below the top plate as illustrated in Figure 6.27.

The top and bottom of stairs through floor levels that contain concealed space within the assembly normally require a doubling of joists for structural integrity and in so doing provide a fire block as seen in Figure 6.28.

Residential occupancies considered under this guide assume that sprinklers are not provided. In row-dwelling unit construction the attic space must be separated into fire compartments of not larger than 300 m² (3230 ft²) with fire blocks where the materials in the attic have a flamespread rating of greater than 25. Note that the maximum dimension of this area cannot be greater than 20 m (65' 7").

Concealed spaces that are created in gambrel or mansard type roofs, or in balconies or canopies require fire blocks as illustrated in Figure 6.29.

Where fire blocks are pierced by pipes, ducts or other elements, the effectiveness of the fire blocks must be maintained around these elements.

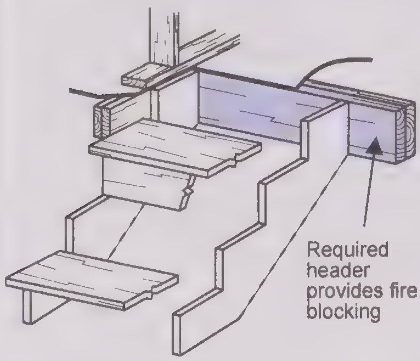


Figure 6.28
Stair Fire Blocking (9.10.16.1.(3))

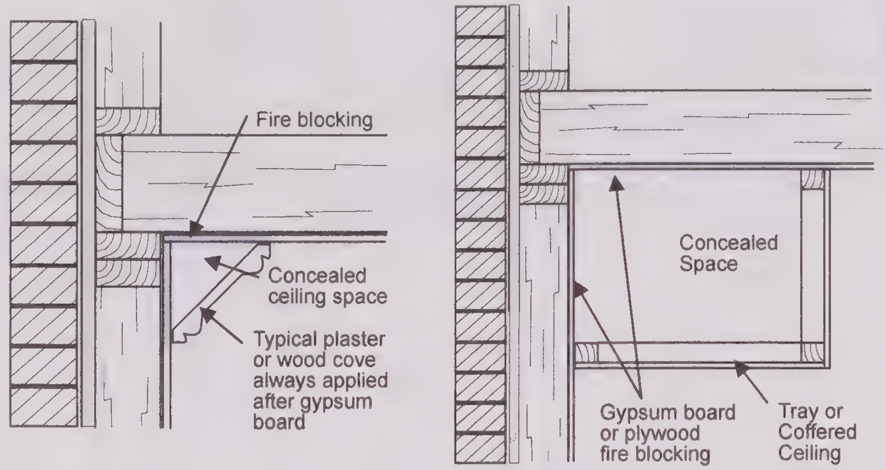


Figure 6.27
Fire Block for Coved or Coffered Ceiling (9.10.16.1.(2))

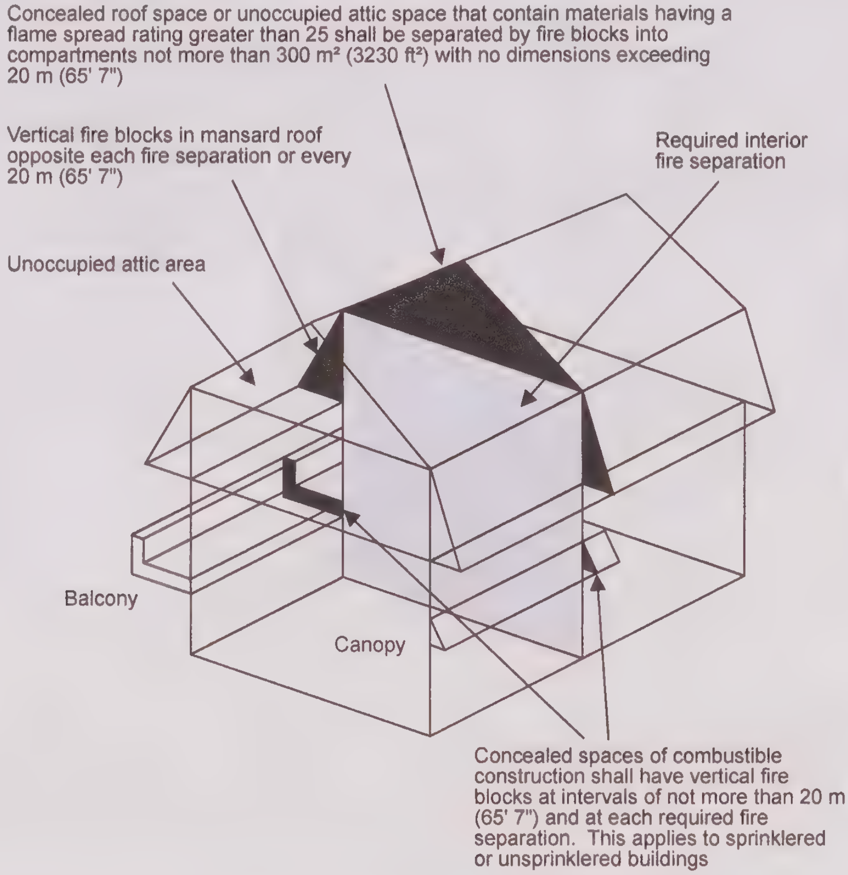


Figure 6.29
Fire Blocks in Concealed Spaces of Mansard Roofs (9.10.16.1.) (9.10.16.2.)

Openings & Service Penetrations in Fire Separations

Fire separations with openings require that the type of opening be tested and rated to maintain the integrity of the assembly. An exemption for this requirement includes electrical boxes in ceilings and walls provided that they are tightly fitted or caulked with a fire retardant treated material if necessary (if not tightly fitted) and are not greater than 160 cm² (25 in²) in area (the size of a 4-gang electrical box).

In wall assemblies, electrical boxes located on opposite sides of the wall must be offset in stud spacing. Refer to Figure 6.30 which also includes wall plan details for double stud and staggered stud wall assemblies.

Electrical wires can partly or wholly pass through fire separations provided they are in noncombustible jacketing, or if they are in combustible jacketing, they must not exceed 25 mm (1") in overall diameter.

Service penetrations through fire separations require special consideration. Refer to Subsection 9.10.9. of the Code for relevant sentences.

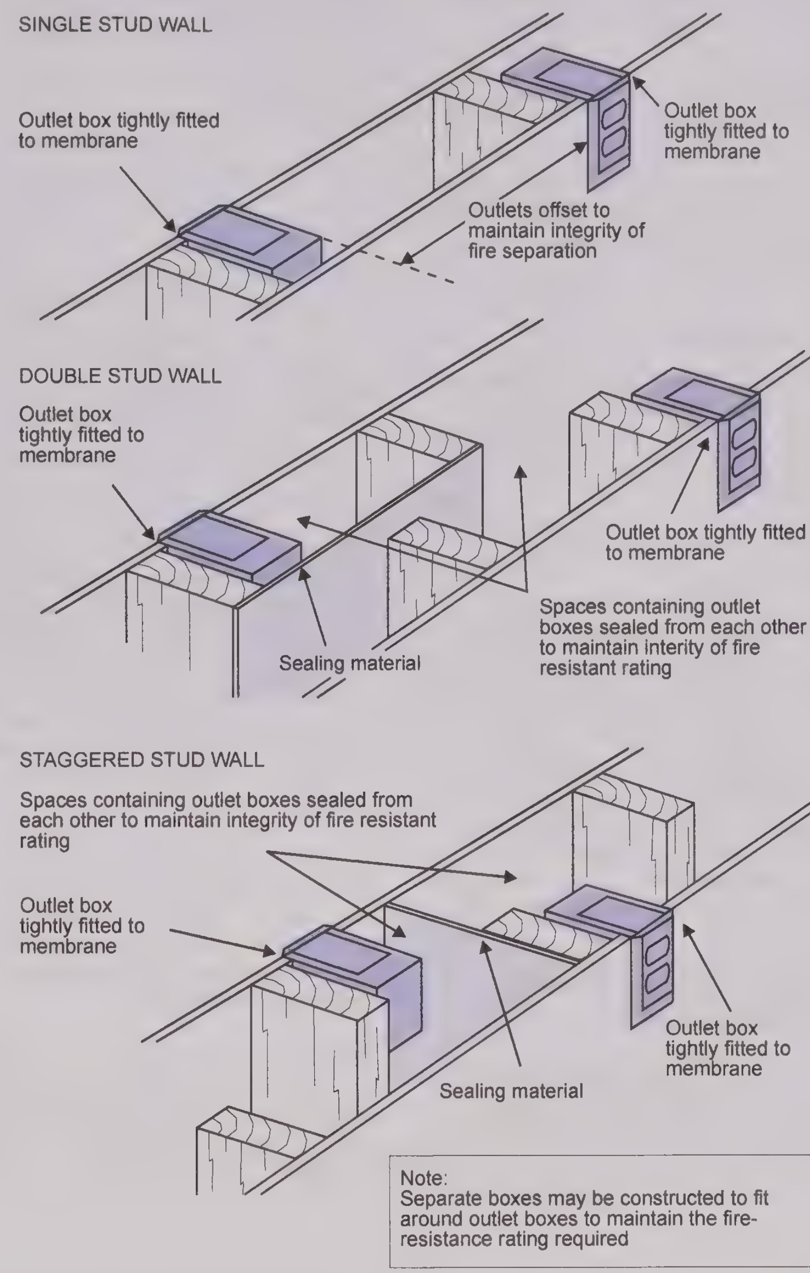


Figure 6.30
Outlet Boxes in Fire Separations (9.10.9.6.(4))

SUPPRESSION OF FIRE

BUILDING CODE REFERENCES

DIVISION B
9.10.20.3. Fire Department Access to Buildings

The suppression of a fire relates to the provisions directed towards extinguishing fires within homes.

Sprinkler Systems

The Codes does not require sprinkler systems in houses. However, where sprinklers are installed voluntarily, Code requirements for sprinkler systems will apply.

Fire Fighting

The fire department must be able to access any dwelling unit from a street, private road, or through a private yard. Where provision for the above is made by private road or yard, consideration must be made for connections to main thoroughfares, width of access, turning radii of fire department vehicles, locality of fire department, and public and private parking. Local fire departments can provide additional detail.

Better Building Note

While not required by the Code, it is recommended to provide a fire extinguisher in all dwelling units.

REQUIREMENTS FOR SOUND CONTROL

BUILDING CODE REFERENCES

DIVISION B
9.11.1.1. Determination of Sound Class Transmission Ratings
9.11.2.1. Minimum Sound Transmission Class Ratings

The sound control provisions of the Code deal with transmission of airborne sound between dwelling units. External noise, impact sounds or vibrations are not dealt with under the requirements of sound control.

Sound Transmission Class Ratings

Sound transmission class (STC) ratings are determined based on ASTM E413, "Classification for Rating Sound Insulation" which relies on the results of ASTM E90 "Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements" or ASTM E336 "Measurement of Airborne Sound Insulation in Buildings".

Sound transmission can be defined as the sound that penetrates a separation or partition. Within the scope of this guide, only semi-detached and row housing would require consideration of the STC of shared walls.

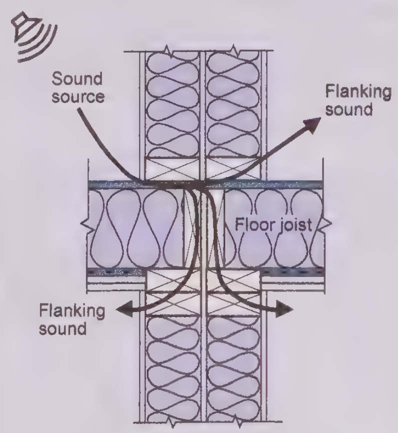
Listed sound ratings assume no voids or cracks, and require that sound absorptive materials (rock, slag or glass fibre) fill at least 90% of the cavity space.

Required Sound Controls

The required STC rating for a partition between a residential occupancy and any other attached occupancy from which noise could be generated is to be at least 50. This must conform with the ratings shown in Figure 6.3 or to the ASTM Documents listed in 9.11.1.

A sound rated partition must be constructed so it will be an effective barrier for sound. Requirements for fire blocks and fire separations also help ensure that sound control is attained. The staggering of electrical boxes in a fire separation is a requirement in Article 9.10.9.6. of the Code.

Sound Transmission



Sound that is transmitted into an assembly can short-circuit the cavity though continuous layers of material at the top, bottom or sides of the assembly

Better Building Note

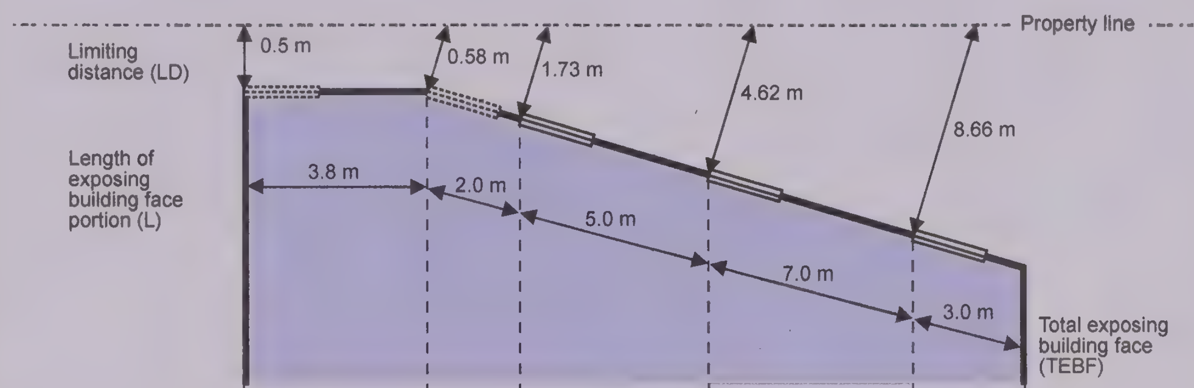
Research indicates that most performance problems in sound barriers are due to air leaks. As such, it is very important to ensure that assemblies intended to control sound are tightly sealed.

This is particularly so in assemblies which rely on dead air space for the control of sound transmission.

WORKED EXAMPLE

Fire Safety: Calculation of Spatial Separation Requirements

Example A: Skewed Wall with an Arbitrary Division of the Wall and a Height of 2.4 m (7' 10")



	1	2	3	4	5
Portion of exposing building face area (A)	9.12 m²	4.8 m²	12 m²	16.8 m²	7.2 m²
Percentage (%) of glazed openings permitted	0	0	8%	28%	100%
Permitted glazed openings	0	0	0.96 m²	4.7 m²	7.2 m²
Fire-resistance rating	45 minutes	45 minutes	Not required	Not required	Not required
Noncombustible cladding	Required	Required	Not required	Not required	Not required

Solution A

Step 1: Determine the limiting distance of each portion of the exposing building face.
(example: LD1 = 0.5 m)

Step 2: Calculate the area of each portion.
(example: A1 = 3.8 m x 2.4 m = 9.12 m²)

Step 3: Calculate the TEBF (total length x height = 20.8 x 2.4 = 50 m²) and use Figure 6.9 to find the corresponding row from which the maximum permitted percentage area of glazed openings will be read. Along that row, identify the percentage of glazed openings permitted for each portion using the limiting distance from Step 1.
(example: Figure 6.9 shows that any LD less than 1.2 m does not permit any glazing)

Step 4: Calculate the area of glazed openings permitted for each portion.
(example: 0 x 9.12 m² = 0 m²)

Step 5: Use Figure 6.7 to determine the required fire-resistance rating and cladding.
(example: Figure 6.7 shows that any LD less than 0.6 m requires a 45 minute FRR and nonconbustible cladding)

7 WALL SYSTEMS

Wall framing represents the building's skeleton. Walls carry vertical loads from the roof, floors and the wall itself and transfer these loads to the dwelling unit foundation. Walls help control fire by limiting fire spread across interior walls, between fire compartments, and between adjacent buildings. Wall framing supports interior and exterior finishes. Exterior walls control the movement of heat, moisture and air into and out of the building.

This chapter details the Code requirements as they relate to wood-frame, masonry, steel stud and insulating concrete form wall assemblies. The structural aspects of these wall assemblies are emphasized here.

Requirements pertaining to walls which relate to the control of heat, air and moisture movement are outlined in subsequent chapters; notably, Chapter 13: Energy Efficiency, Air and Vapour Barriers, Chapter 14: Interior Finishes, Chapter 15: Exterior Finishes, and Chapter 6: Fire Safety and Sound Control.

KEY POINTS

Wall systems must be designed and constructed to fulfill the following functions:

- transfer the structural loads of the building to the dwelling unit foundation;
- resist racking from winds and building settlement;
- help control the spread and movement of fire, and
- control the flow of heat, moisture, and air into and out of the dwelling.

Wood Framing Methods

Wood framing methods include platform, balloon, and post and beam.

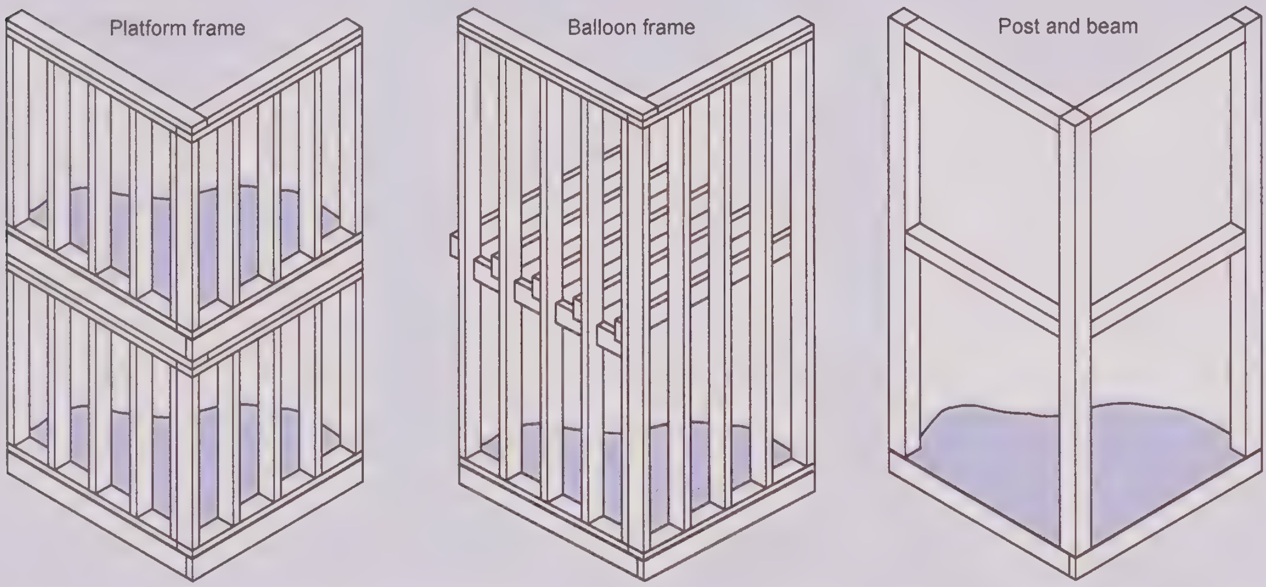
Platform framing is the most common framing method used in Ontario. Its main advantage is that the floor system is assembled independently from the walls and provides a working surface upon which walls and partitions are built for the next floor. Walls are one storey in height and can be easily lifted into place without the use of lifting equipment.

Fire blocking is an integral part of the wall system, eliminating much of the need to cut and fit short fire stops within the wall assembly.

Balloon framing involves the erection of walls around the building interior prior to the construction of floors. Floor joists are supported on ribbons let into the walls of the building.

Fire blocking is necessary at each floor and every 3m (10') along a vertical cavity.

Post and beam framing is the assembly of framing members at a spacing that exceeds 610 mm (24"). Infill wall panels of plywood waferboard are often incorporated in post and beam buildings. The sizing of framing members used in post and beam houses must conform to the requirements of Part 4 of the Code.



WOOD-FRAME WALL CONSTRUCTION

BUILDING CODE REFERENCES

DIVISION B

3.8.3.8.	Water Closet Stalls
3.8.3.13.	Showers and Bathtubs
9.17.4.2.	Materials
9.23.3.5.	Fastening for Sheathing or Subflooring
9.23.5.3.	Wall Studs
9.23.5.4.	Top Plates
9.23.10.1.	Stud Size and Spacing
9.23.10.2.	Bracing and Lateral Support
9.23.10.3.	Orientation of Studs
9.23.10.4	Continuity of Studs
9.23.10.5.	Support for Cladding Materials
9.23.10.6.	Studs at Sides of Openings
9.23.10.7.	Stud Posts Built into Walls
9.23.11.2.	Bottom Wall Plates
9.23.11.3.	Top Plates
9.23.11.4.	Joints in Top Plates
9.23.12.1.	Openings in Non-Loadbearing Walls
9.23.12.2.	Openings in Loadbearing Walls
9.23.12.3.	Lintel Spans and Sizes
9.23.16.1.	Required Sheathing
9.23.16.2.	Thickness, Rating and Material Standards
9.23.16.3.	Attachment of Cladding to Sheathing
9.23.16.4.	Lumber Sheathing
9.23.16.5.	Joints in Panel-Type Sheathing
9.27.3.2.	Sheathing Membrane Material Standard
9.27.3.3.	Required Sheathing Membrane and Installation
9.27.3.4.	Insulating Sheathing in Lieu of Sheathing Membrane
9.27.3.5.	Sheathing Membranes in Lieu of Sheathing
9.27.3.6.	Face Sealed Cladding

Conventionally, houses in Canada have been constructed using wood frames; that is, the main structural components of the building consist of wood elements which are closely spaced together to form a frame which supports the building's superimposed loads. The wood framing members used in this type of construction are spaced no more than 610 mm (24") apart. Post and beam construction on the other hand uses members spaced at more than 610 mm (24"). Walls which contain framing members space more than 610 mm (24") apart fall within the scope of Part 4 and therefore will need to be designed by a qualified individual.

WALL STUDS

Wall studs are the vertical components to which sheathing, cladding and interior finishes are attached. The studs support loads from the roof and/or other floors. They sit on the bottom wall plate and transfer the load to beams, other walls or directly to the foundation. Stud lumber should be straight with a moisture content of no more than 19%. (Refer to Code Article 9.3.2.5.)

The size and spacing of wood studs is determined by the loads that are supported, the unsupported height of the wall, and whether the wall is an interior or exterior wall.

Figures 7.1 and 7.2 identify the size, spacing and maximum unsupported height for wall studs in dwelling units. Figures 7.3 and 7.4 summarize the size and spacing requirements for exterior tall wall studs (No. 2 Grade Spruce-Pine-Fir only). Additional tall wall designs for other wood species are found in Tables A-30 to A-33 of the Code.

Loadbearing studs must be supported laterally by cladding or blocking and must not be oriented on the flat unless explicitly permitted by the Code. Loadbearing studs must be continuous for the full storey height (except at openings). Studs which are finger jointed with structural adhesive can be used to support loads and must never be oriented on the flat. Special care must be applied when choosing finger jointed studs which are required to act as a fire separation that is required to have a fire-resistance rating. Wall studs located at gable ends must be continuous where there is no ceiling at the top of the platform framing. Studs that are not continuous do not comply with Part 9 of the Code and must be designed using Part 4 of the Code. See Figure 7.5.

Figures 7.6 and 7.7 summarize the requirements for studs that support a girder truss or roof beams (No. 2 Grade Spruce-Pine-Fir only). In all instances these studs must conform to the following requirements:

- the studs must be fastened together to form a post using at least 38 mm (1-1/2") thick full length members where they are either:
  - bolted together with not less than 9.52 mm (3/8") diameter bolts spaced not more than 450 mm (17-3/4") o.c. or
  - nailed together with not less than 76 mm (3") nails spaced not more than 300 mm (11-3/4") o.c.;
- the wall must not be less than 1.2 m (3'11") long and must be sheathed on at least one side using plywood, OSB, waferboard or gypsum sheathing; and the wall sheathing must be fastened to the stud post with at least one row of fasteners conforming to Figure 7.17 and must be spaced not less than 150 mm (5-7/8") o.c.; and
- the width of the stud post must be not less than the width of the girder or beam that it supports.

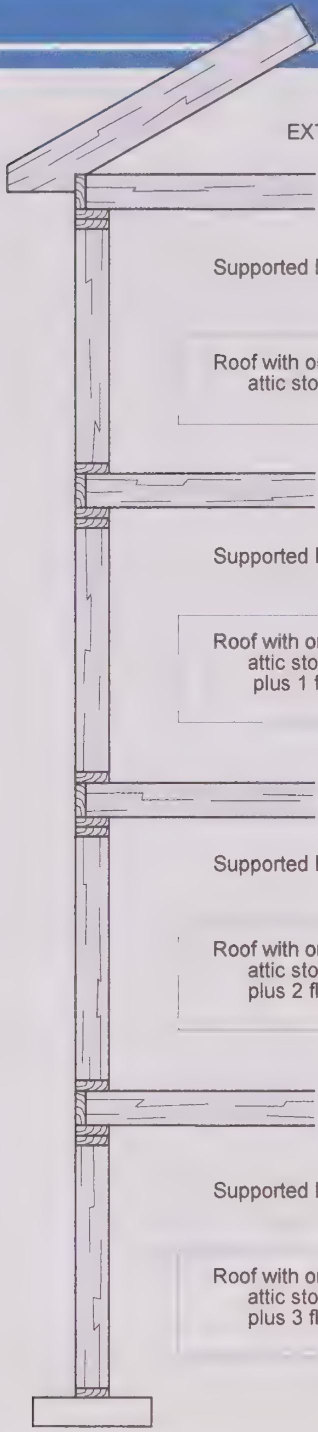
All other stud posts not within these requirements must be designed in accordance with Part 4 of the Code.

Better Building Note

Alignment of wall studs with floor joists permits greated flexibility in the location and installation of ductwork and plumbing.

Size and Spacing of Studs for Exterior Walls

EXTERIOR WALLS



Supported Load	Minimum Stud Size	Maximum Stud Spacing	Maximum Unsupported Height
Roof with or without attic storage	38 mm x 64 mm (2 x 3)	406 mm (16")	2.4 m (7' 10")
	38 mm x 89 mm (2 x 4)	610 mm (24")	3.0 m (9' 10")

Supported Load	Minimum Stud Size	Maximum Stud Spacing	Maximum Unsupported Height
Roof with or without attic storage plus 1 floor	38 mm x 89 mm (2 x 4)	406 mm (16")	3.0 m (9' 10")
	38 mm x 140 mm (2 x 6)	610 mm (24")	3.0 m (9' 10")

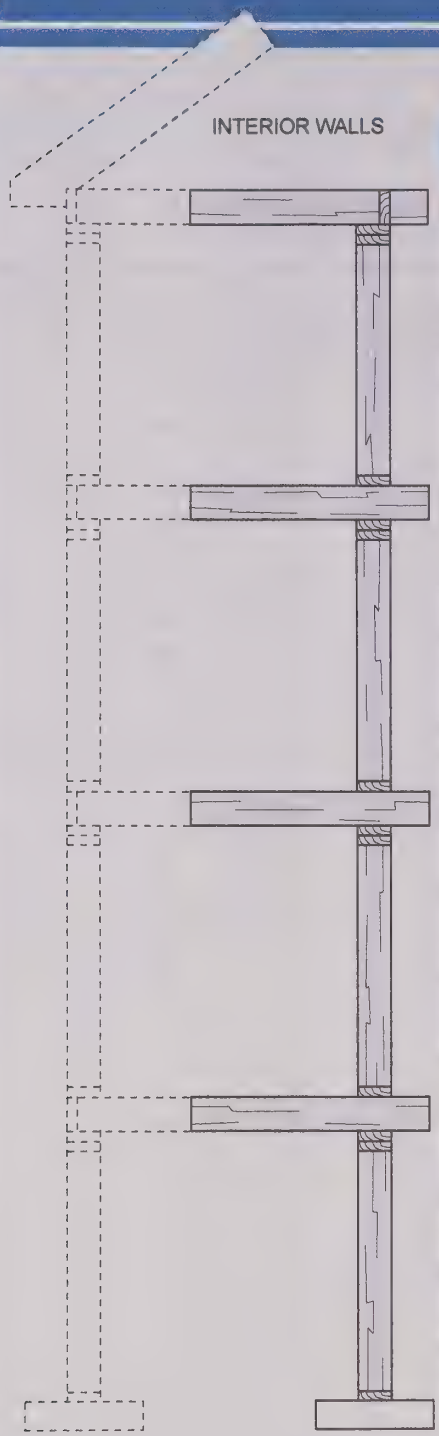
Supported Load	Minimum Stud Size	Maximum Stud Spacing	Maximum Unsupported Height
Roof with or without attic storage plus 2 floors	38 mm x 89 mm (2 x 4)	305 mm (12")	3.0 m (9' 10")
	64 mm x 89 mm (3 x 4)	406 mm (16")	3.0 m (9' 10")
	38 mm x 140 mm (2 x 6)	406 mm (16")	3.6 m (11' 10")

Supported Load	Minimum Stud Size	Maximum Stud Spacing	Maximum Unsupported Height
Roof with or without attic storage plus 3 floors	38 mm x 140 mm (2 x 6)	305 mm (12")	1.8 m (5' 11")

Figure 7.1
Size and Spacing of Studs

(9.23.10.1.)

Size and Spacing of Studs for Interior Walls



Supported Load	Minimum Stud Size	Maximum Stud Spacing	Maximum Unsupported Height
No load	38 mm x 38 mm (2 x 2) 38 mm x 89 mm (2 x 4) flat *	406 mm (16") 406 mm (16")	2.4 m (7' 10") 3.6 m (11' 10")
Attic not accessible by a stairway	38 mm x 64 mm (2 x 3) 38 mm x 64 mm (2 x 3) flat * 38 mm x 89 mm (2 x 4) 38 mm x 89 mm (2 x 4) flat *	610 mm (24") 406 mm (16") 610 mm (24") 406 mm (16")	3.0 m (9' 10") 2.4 m (7' 10") 3.6 m (11' 10") 2.4 m (7' 10")

*See Article 9.23.10.3. for applications where studs on the flat are permitted

Supported Load	Minimum Stud Size	Maximum Stud Spacing	Maximum Unsupported Height
Roof Load Attic accessible by stairway Attic not accessible by stairway plus 1 floor	38 mm x 64 mm (2 x 3) 38 mm x 89 mm (2 x 4)	406 mm (16") 610 mm (24")	2.4 m (7' 10") 3.6 m (11' 10")
Roof Load plus 1 floor Attic accessible by stairway plus 1 floor Attic not accessible by stairway plus 2 floors	38 mm x 89 mm (2 x 4)	406 mm (16")	3.6 m (11' 10")
Roof Load plus 2 floors Attic accessible by stairway plus 2 floors	38 mm x 89 mm (2 x 4) 64 mm x 89 mm (3 x 4) 38 mm x 140 mm (2 x 6)	305 mm (12") 406 mm (16") 406 mm (16")	3.6 m (11' 10") 3.6 m (11' 10") 4.2 m (13' 9")
Roof Load plus 3 floors Attic accessible by stairway plus 3 floors	38 mm x 140 mm (2 x 6)	305 mm (12")	4.2 m (13' 9")

Figure 7.2
Size and Spacing of Studs

(9.23.10.1.)

Stud Size and Spacing for Spruce-Pine-Fir No. 2 Grade Exterior Wall Studs with Brick Veneer

LEGEND
Stud Size and Spacing

- **A** 38 mm x 140 mm @ 406 mm o.c. (2 x 6 @16" o.c.)
- **B** 38 mm x 140 mm @ 305 mm o.c. (2 x 6 @ 12" o.c.)
- **C** two 38 mm x 140 mm @ 406 mm o.c. (2 x 6 @ 16" o.c.)
- **D** two 38 mm x 140 mm @ 305 mm o.c. (2 x 6 @ 12" o.c.)

Hourly Wind Pressure (1/50) (kPa)		0.40		0.45		0.50		0.60	
Specified Roof Design Snow Load (kPa)	Stud Length m (ft-in)	Supported Roof Length		Supported Roof Length		Supported Roof Length		Supported Roof Length	
		3.0 m (9' 10")	6.0 m (19' 8")	3.0 m (9' 10")	6.0 m (19' 8")	3.0 m (9' 10")	6.0 m (19' 8")	3.0 m (9' 10")	6.0 m (19' 8")
1.0	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	B	B	B	B
	4.6 (15' 1")	B	B	B	B	C	C	C	C
	5.0 (16' 4")	C	C	C	C	C	C	D	D
	5.3 (17' 4")	C	C	C	C	D	D	D	D
	5.6 (18' 4")	C	C	D	D	D	D	-	-
1.5	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	B	B	B	B
	4.6 (15' 1")	B	B	B	B	C	C	C	C
	5.0 (16' 4")	C	C	C	C	C	C	D	D
	5.3 (17' 4")	C	C	C	C	D	D	D	D
	5.6 (18' 4")	C	C	D	D	D	D	-	-
2.0	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	B	B	B	B
	4.6 (15' 1")	B	B	B	B	C	C	C	C
	5.0 (16' 4")	C	C	C	C	C	C	D	D
	5.3 (17' 4")	C	C	C	C	D	D	D	D
	5.6 (18' 4")	C	C	D	D	D	D	-	-
2.5	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	B	B	B	B
	4.6 (15' 1")	B	B	B	B	C	C	C	C
	5.0 (16' 4")	C	C	C	C	C	C	D	D
	5.3 (17' 4")	C	C	C	C	D	D	D	D
	5.6 (18' 4")	C	C	D	D	D	D	-	-
3.0	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	B	B	B	B
	4.6 (15' 1")	B	B	B	B	C	C	C	C
	5.0 (16' 4")	C	C	C	C	C	C	D	D
	5.3 (17' 4")	C	C	C	C	D	D	D	D
	5.6 (18' 4")	C	C	D	D	D	D	-	-

Notes
(1) A roof dead load of 0.5 kPa (10 psf) has been assumed. The Table does not apply where the stud supports additional loads from heavy roofing materials such as concrete tiles or clay roofing tiles.
(2) Wall construction shall conform to the requirements of Sentence 9.23.10.1.(2)

Figure 7.3
Sizes for Exterior Wall Studs with Brick Veneer (9.23.10.1.)

Stud Size and Spacing for Spruce-Pine-Fir No. 2 Grade Exterior Wall Studs with Siding

LEGEND
Stud Size and Spacing

- **A** 38 mm x 140 mm @ 406 mm o.c. (2 x 6 @16" o.c.)
- **B** 38 mm x 140 mm @ 305 mm o.c. (2 x 6 @ 12" o.c.)
- **C** two 38 mm x 140 mm @ 406 mm o.c. (2 x 6 @ 16" o.c.)
- **D** two 38 mm x 140 mm @ 305 mm o.c. (2 x 6 @ 12" o.c.)

Hourly Wind Pressure (1/50) (kPa)		0.40		0.45		0.50		0.60	
Specified Roof Design Snow Load (kPa)	Stud Length m (ft-in)	Supported Roof Length		Supported Roof Length		Supported Roof Length		Supported Roof Length	
		3.0 m (9' 10")	6.0 m (19' 8")	3.0 m (9' 10")	6.0 m (19' 8")	3.0 m (9' 10")	6.0 m (19' 8")	3.0 m (9' 10")	6.0 m (19' 8")
1.0	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	A	A	A	A
	4.6 (15' 1")	A	A	A	A	A	A	A	A
	5.0 (16' 4")	A	A	A	A	A	A	B	B
	5.3 (17' 4")	A	A	A	A	B	B	B	B
	5.6 (18' 4")	A	A	B	B	B	B	C	C
1.5	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	A	A	A	A
	4.6 (15' 1")	A	A	A	A	A	A	A	A
	5.0 (16' 4")	A	A	A	A	A	A	B	B
	5.3 (17' 4")	A	A	A	A	B	B	B	B
	5.6 (18' 4")	A	A	B	B	B	B	C	C
2.0	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	A	A	A	A
	4.6 (15' 1")	A	A	A	A	A	A	A	A
	5.0 (16' 4")	A	A	A	A	A	A	B	B
	5.3 (17' 4")	A	A	A	A	B	B	B	B
	5.6 (18' 4")	A	A	B	B	B	B	C	C
2.5	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	A	A	A	A
	4.6 (15' 1")	A	A	A	A	A	A	A	A
	5.0 (16' 4")	A	A	A	A	A	A	B	B
	5.3 (17' 4")	A	A	A	A	B	B	B	B
	5.6 (18' 4")	A	B	B	B	B	B	C	C
3.0	**3.8** (12' 5")	A	A	A	A	A	A	A	A
	4.2 (13' 9")	A	A	A	A	A	A	A	A
	4.6 (15' 1")	A	A	A	A	A	A	A	A
	5.0 (16' 4")	A	A	A	A	A	A	B	B
	5.3 (17' 4")	A	B	A	B	B	B	B	B
	5.6 (18' 4")	A	B	B	B	B	B	C	C

Notes
(1) A roof dead load of 0.5 kPa (10 psf) has been assumed. The Table does not apply where the stud supports additional loads from heavy roofing materials such as concrete tiles or clay roofing tiles.
(2) Wall construction shall conform to the requirements of Sentence 9.23.10.1.(2)

Figure 7.4
Sizes for Exterior Wall Studs with Siding (9.23.10.1.)

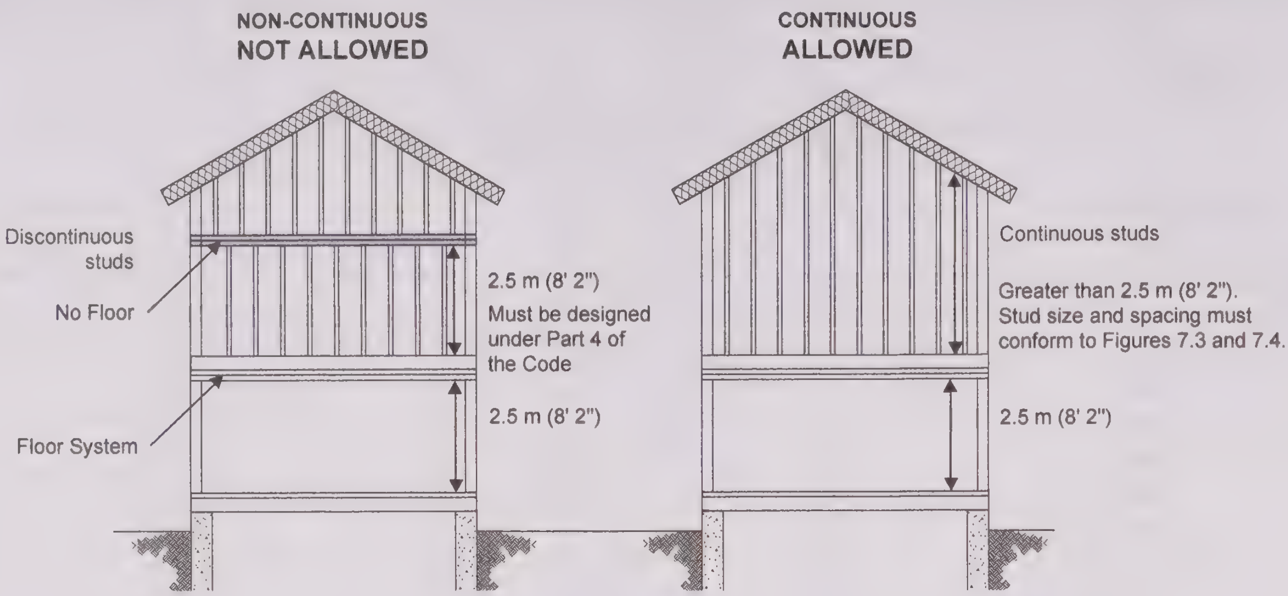


Figure 7.5
Tall Wall Studs for Platform Framing Under Part 9 of the Code (9.23.10.4.)

Minimum Number of 38 x 89 mm (2 x 4) Spruce-Pine-Fir Stud Posts																					
Stud Height m (ft-in)		Specified Roof Design Snow Load, kPa (psf)																			
		1.0 (20.9)				1.5 (31.3)				2.0 (41.8)				2.5 (52.2)				3.0 (62.7)			
		Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m			
		2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0
2.4 (7' 10")	2.4 (7' 10")	1	1	2	2	1	2	2	2	1	2	2	3	2	2	2	3	2	2	3	3
	3.6 (11' 10")	1	2	2	2	2	2	3	3	2	2	3	4	2	3	3	4	2	3	4	5
	4.8 (15' 9")	2	2	3	3	2	3	3	4	2	3	4	5	3	4	4	-	3	4	5	-
	6.0 (19' 8")	2	2	3	4	2	3	4	5	3	4	5	-	3	4	5	-	3	5	-	-
	7.2 (23' 7")	2	3	4	4	3	4	5	-	3	4	-	-	4	5	-	-	4	-	-	-
	8.4 (27' 7")	2	3	4	5	3	4	5	-	3	5	-	-	4	-	-	-	5	-	-	-
	9.6 (31' 6")	3	4	5	-	3	5	-	-	4	-	-	-	5	-	-	-	5	-	-	-
	10.8 (35' 5")	3	4	5	-	4	5	-	-	4	-	-	-	5	-	-	-	-	-	-	-
	12.0 (39' 4")	3	4	-	-	4	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-
2.4 (7' 10")	2.4 (7' 10")	1	2	2	2	2	2	3	3	2	2	3	2	2	3	4	2	2	3	4	5
	3.6 (11' 10")	2	2	3	3	2	3	4	4	2	3	4	2	3	4	5	3	3	4	-	-
	4.8 (15' 9")	2	3	4	4	3	4	5	-	3	4	-	3	4	5	-	4	4	-	-	-
	6.0 (19' 8")	2	3	4	5	3	4	-	-	4	5	-	4	4	-	-	4	5	-	-	-
	7.2 (23' 7")	3	4	5	-	4	5	-	-	4	-	-	4	5	-	-	5	-	-	-	-
	8.4 (27' 7")	3	4	-	-	4	-	-	-	5	-	-	5	-	-	-	-	-	-	-	-
	9.6 (31' 6")	4	5	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10.8 (35' 5")	4	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12.0 (39' 4")	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
(1) A roof dead load of 0.62 kPa (13 psf) has been assumed.
(2) Roof beams require a minimum bearing length of 89 mm (3-1/2").
(3) Girder trusses require a minimum bearning length of 89 mm (3-1/2") unless otherwise specified by the truss manufacturer.

Figure 7.6
Minimum Number of Stud Posts in Exterior Stud Walls Supporting Girder Trusses and Roof Beams (9.23.10.7.(2))

Minimum Number of 38 x 89 mm (2 x 4) Spruce-Pine-Fir Stud Posts

Stud Height m (ft-in)		Specified Roof Design Snow Load, kPa (psf)																			
		1.0 (20.9)				1.5 (31.3)				2.0 (41.8)				2.5 (52.2)				3.0 (62.7)			
		Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m			
		2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0
3.0 (9' 10")	2.4 (7' 10")	1	1	1	1	1	1	1	1	1	1	2	2	1	1	2	2	1	1	2	2
	3.6 (11' 10")	1	1	1	1	1	1	2	2	1	1	2	2	1	2	2	2	1	2	2	3
	4.8 (15' 9")	1	1	2	2	1	2	2	2	1	2	3	3	2	2	3	3	2	2	3	4
	6.0 (19' 8")	1	1	2	2	1	2	2	3	2	2	3	4	2	2	3	4	2	3	4	4
	7.2 (23' 7")	1	2	2	2	2	2	3	3	2	2	4	4	2	3	4	4	2	3	4	5
	8.4 (27' 7")	1	2	2	3	2	2	3	4	2	3	4	5	3	3	4	5	3	4	5	-
	9.6 (31' 6")	2	2	3	3	2	3	3	4	2	3	5	-	3	4	5	-	3	4	5	-
	10.8 (35' 5")	2	2	3	3	2	3	4	4	2	3	5	-	3	4	5	-	3	5	-	-
	12.0 (39' 4")	2	2	3	4	2	3	4	5	3	4	-	-	4	4	-	-	4	5	-	-
2.6 (11' 10")	2.4 (7' 10")	1	1	1	1	1	1	1	2	1	1	2	2	1	1	2	2	1	2	2	2
	3.6 (11' 10")	1	1	1	2	1	1	2	2	1	2	2	3	1	2	2	2	2	2	3	3
	4.8 (15' 9")	1	1	2	2	1	2	2	3	2	2	3	3	2	2	3	4	2	3	4	4
	6.0 (19' 8")	1	2	2	3	2	2	3	3	2	3	3	4	2	3	4	5	2	3	4	5
	7.2 (23' 7")	1	2	2	3	2	2	3	4	2	3	4	5	2	3	4	5	3	4	5	-
	8.4 (27' 7")	2	2	3	3	2	3	4	4	2	3	4	5	3	4	5	-	3	4	-	-
	9.6 (31' 6")	2	2	3	4	2	3	4	5	3	4	5	-	3	4	-	-	4	5	-	-
	10.8 (35' 5")	2	3	3	4	2	3	4	5	3	4	5	-	3	5	-	-	4	-	-	-
	12.0 (39' 4")	2	3	4	5	3	4	5	-	3	5	-	-	4	5	-	-	4	-	-	-

Nores:
(1) A roof dead load of 0.62 kPa (13 psf) has been assumed.
(2) Roof beams require a minimum bearing length of 140 mm (5-1/2").
(3) Girder trusses require a minimum beaming length of 140 mm (5-1/2") unless otherwise specified by the truss manufacturer.

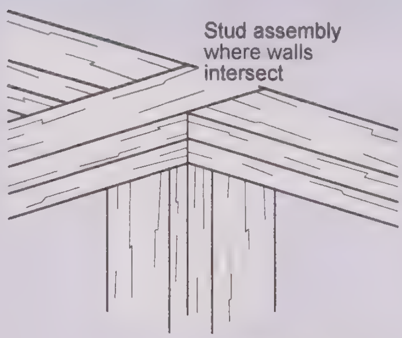
Figure 7.7
Minimum Number of Stud Posts in Exterior Stud Walls Supporting Girder Trusses and Roof Beams (9.23.10.7.(2))

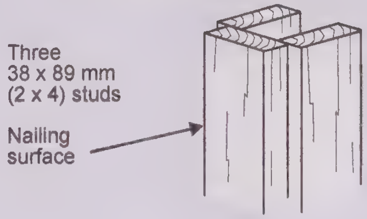
Looking Ahead

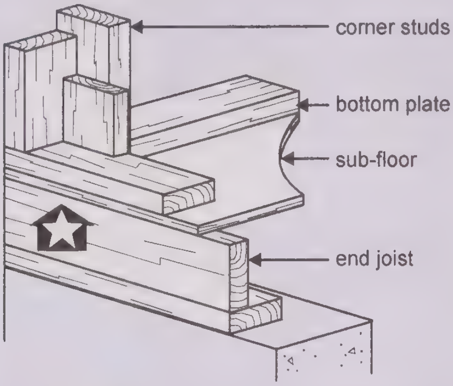
Corners and wall intersections must provide adequate support for the vertical edges of the interior finish to be installed.

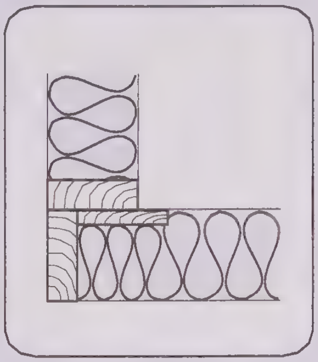
Alternative approaches to corner framing are presented in the figures below.

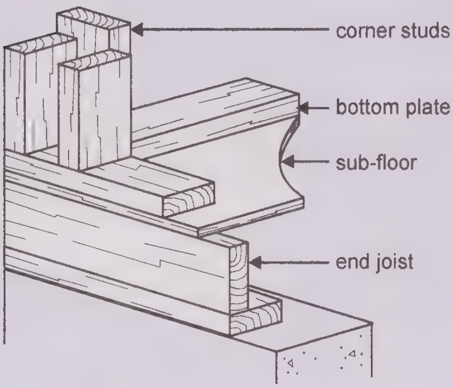
No less than two studs must be used at exterior corners.

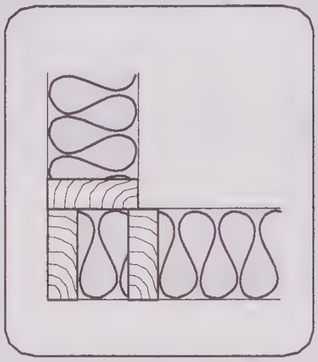




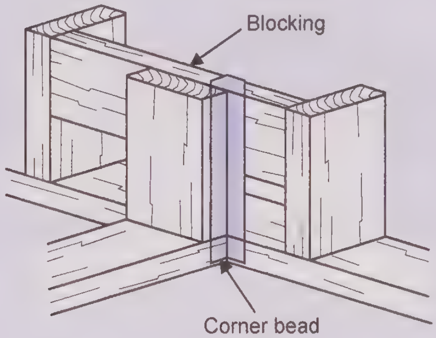


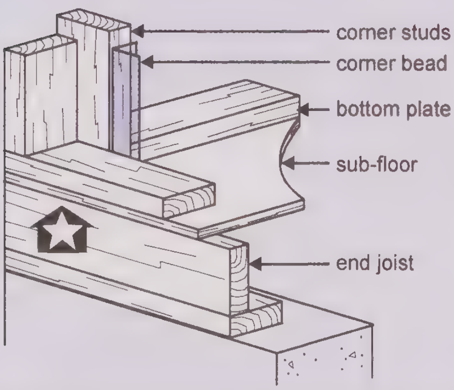


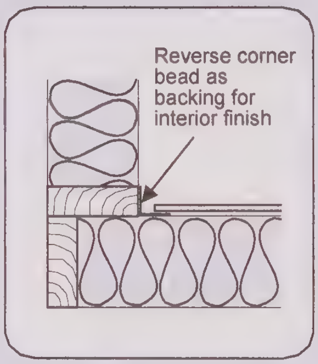


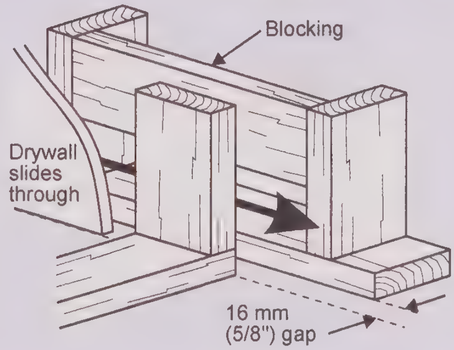


Where intersecting walls fall between two studs, use 38 x 89 mm (2 x 4) blocking and drywall clips or reversed corner bead to provide a nailing surface









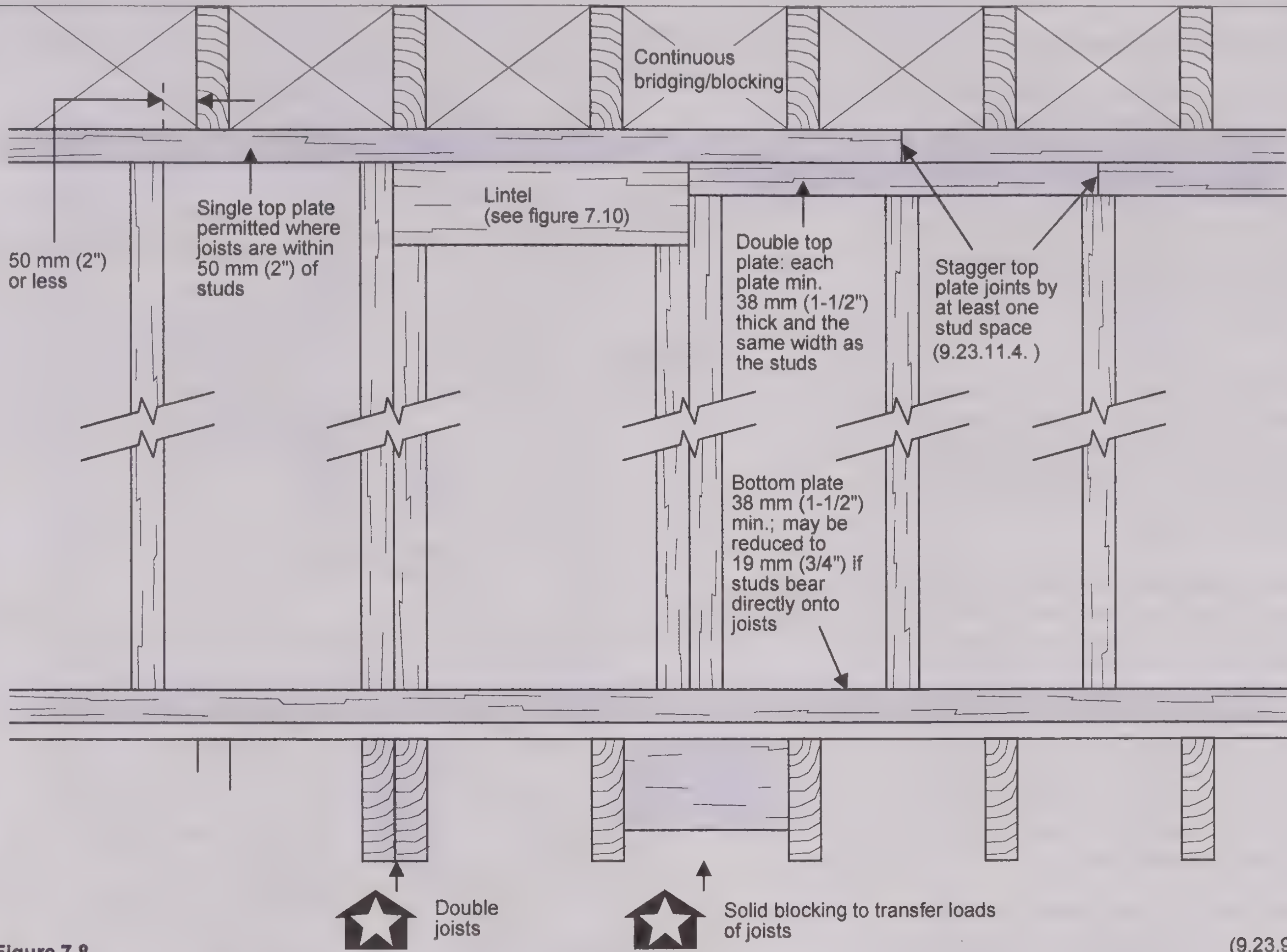


Figure 7.8
Wall Plates for Load Bearing Walls
(9.23.9.)
(9.23.11.)

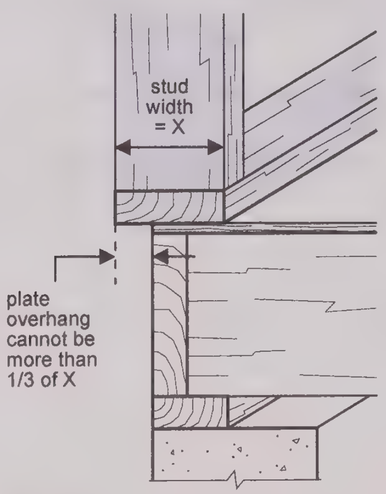


Figure 7.9
Wall Plate
(9.23.11.2.)

Wall Plates

Wall plates are installed at the top and bottom of the wall. Top plates for load-bearing walls are generally doubled except where concentrated loads are within 50 mm (2") of the supported stud or where a lintel is provided. Figures 7.8 and 7.9 illustrate requirements as they relate to wall plates.

At corners, top plates must be lapped or otherwise suitably tied as shown in Figure 7.10.

Better Building Note

Temporary bracing during construction will be required to resist wind forces and to maintain the rigidity of the building as it is being erected.

Framing Over Openings

Studs are generally doubled at openings such as doors and windows. The inner studs extend from the lintel to the bottom wall plate and the outer studs from the top wall plate to the bottom wall plate. Lintels are beam-like elements above openings in walls. Single studs can only be used on each side of openings in non-loadbearing interior walls.

Wall plates must be continuous across openings to provide continuity around the opening. Figure 7.11 illustrates approaches that can be used to maintain the continuity of wall plates across openings in walls.

Lintels in wood frame walls are usually formed from two pieces of 38 mm (1-1/2") lumber which are nailed together with 82 mm (3-1/4") nails spaced no more than 450 mm (17-3/4") apart in two rows as shown in Figure 7.12. The depth of the lintel is determined by the size of the opening being spanned, the load supported by the lintel and whether the opening is in an interior or exterior wall.

Lintel sizes can be selected from Figure 7.14 and 7.15 given the span of the lintel. Part 4 of the Code must be used if the size of the opening exceeds the maximum allowable span shown.

Wood lintels can also be used over openings in foundation walls such as basement windows. Figure 7.13 illustrates a common approach for installing a lintel over a basement window. In these cases the lintel is comprised of the floor header and an additional wooden member.

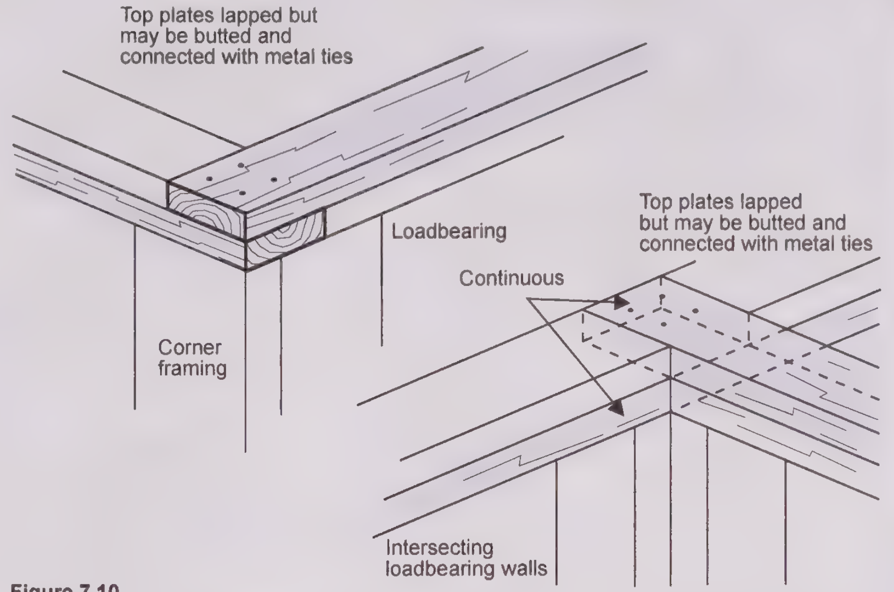


Figure 7.10
Top Plates at Corners

(9.23.11.4.)

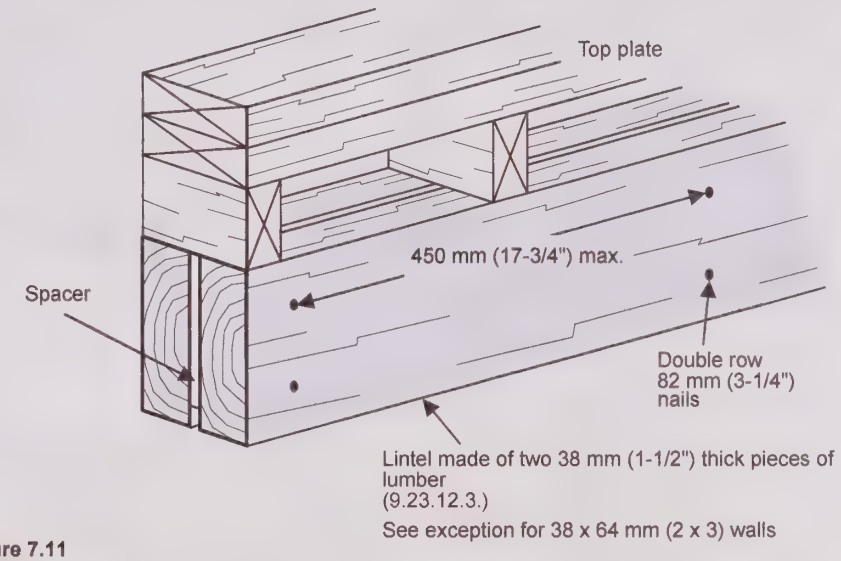


Figure 7.11
Nailing of Lintels

(9.23.12.2.)

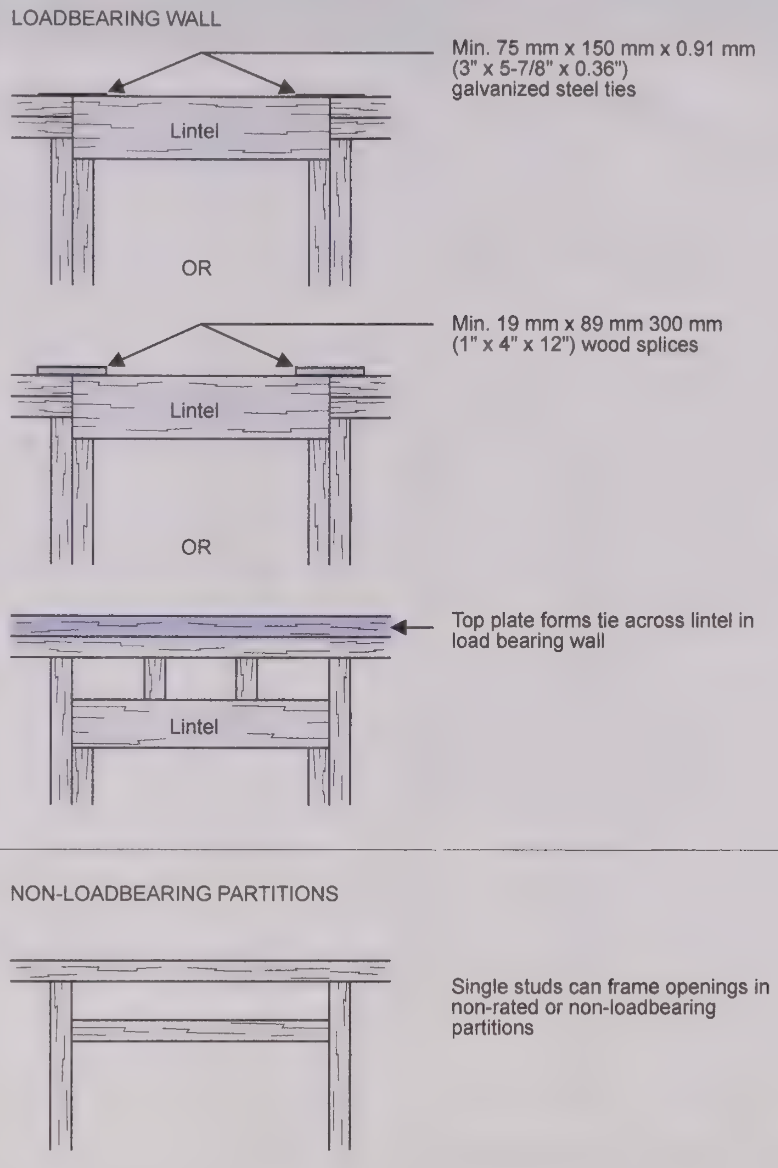


Figure 7.12
Top Plate Ties at Lintels

(9.23.11.3.)

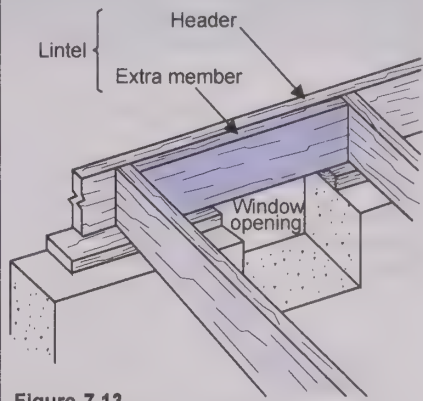


Figure 7.13
Lintel for Basement Window

Maximum Spans for Spruce - Pine - Fir Lintels - No. 1 or No. 2 Grade - Non-Structural Sheathing

Lintel Supporting	Lintel Size mm (in)(2)	Maximum Span(3) (4) m (ft-in) — Exterior Walls — Specified Snow Load, kPa (psf) 1.0 (20.9)	1.5 (31.3)	2.0 (41.8)	2.5 (52.2)	3.0 (62.7)	Interior Walls
Limited Attic Storage and Ceilnig	2-38 x 89 (2 x 4)	This Area Intentionally Left Blank					1.27 (4' 1")
	2-38 x 140 (2 x 6)						1.93 (6' 3")
	2-38 x 184 (2 x 8)						2.35 (7' 8")
	2-38 x 235 (2 x 10)						2.88 (9' 5")
	2-38 x 286 (2 x 12)						3.34 (10' 11")
Roof and Ceiling Only (Tributary width of 0.6 m max.)(5)	2-38 x 89 (2 x 4)	2.55 (8' 4")	2.23 (7' 4")	2.02 (6' 8")	1.88 (6' 2")	1.77 (5' 10")	1.88 (6' 2")
	2-38 x 140 (2 x 6)	4.01 (13' 2")	3.5 (11' 6")	3.18 (10' 5")	2.96 (9' 9")	2.78 (9' 1")	2.96 (9' 9")
	2-38 x 184 (2 x 8)	5.27 (17' 3")	4.61 (15' 1")	4.18 (13' 9")	3.84 (12' 7")	3.66 (12' 0")	3.88 (12' 9")
	2-38 x 235 (2 x 10)	6.37 (20' 11")	5.76 (18' 11")	5.34 (17' 6")	4.96 (16' 3")	4.87 (15' 12")	4.96 (16' 3")
	2-38 x 286 (2 x 12)	7.38 (24' 2")	6.67 (21' 11")	6.21 (20' 4")	5.87 (19' 3")	5.61 (18' 5")	5.87 (19' 3")
Roof and Ceiling Only (Tributary width of 4.9 m max.)(6)	2-38 x 89 (2 x 4)	1.27 (4' 1")	1.11 (3' 7")	1.01 (3' 3")	0.93 (3' 0")	0.87 (2' 10")	0.93 (3' 1")
	2-38 x 140 (2 x 6)	1.93 (6' 3")	1.66 (5' 5")	1.48 (4' 10")	1.35 (4' 5")	1.25 (4' 1")	1.35 (4' 5")
	2-38 x 184 (2 x 8)	2.35 (7' 8")	2.02 (6' 7")	1.80 (5' 10")	1.64 (5' 4")	1.52 (4' 11")	1.64 (5' 5")
	2-38 x 235 (2 x 10)	2.88 (9' 5")	2.47 (8' 1")	2.20 (7' 2")	2.01 (6' 7")	1.84 (6' 0")	2.01 (6' 7")
	2-38 x 286 (2 x 12)	3.34 (10' 11")	2.87 (9' 4")	2.56 (8' 4")	2.33 (7' 7")	2.09 (6' 10")	2.33 (7' 8")
Roof, Ceiling and 1 Storey (3) (6) (7)	2-38 x 89 (2 x 4)	1.05 (3' 5")	0.96 (3' 1")	0.89 (2' 11")	0.84 (2' 9")	0.79 (2' 7")	0.74 (2' 5")
	2-38 x 140 (2 x 6)	1.49 (4' 11")	1.37 (4' 5")	1.27 (4' 1")	1.19 (3' 10")	1.13 (3' 8")	1.02 (3' 4")
	2-38 x 184 (2 x 8)	1.82 (5' 11")	1.67 (5' 5")	1.55 (5' 1")	1.44 (4' 8")	1.33 (4' 4")	1.20 (3' 11")
	2-38 x 235 (2 x 10)	2.22 (7' 3")	2.04 (6' 8")	1.89 (6' 2")	1.73 (5' 8")	1.59 (5' 2")	1.45 (4' 9")
	2-38 x 286 (2 x 12)	2.58 (8' 5")	2.36 (7' 8")	2.15 (7' 0")	1.96 (6' 5")	1.81 (5' 11")	1.66 (5' 5")
Roof, Ceiling and 2 Storeys (3) (6) (7)	2-38 x 89 (2 x 4)	0.94 (3' 1")	0.88 (2' 10")	0.83 (2' 8")	0.79 (2' 7")	0.76 (2' 5")	0.64 (2' 1")
	2-38 x 140 (2 x 6)	1.34 (4' 4")	1.26 (4' 1")	1.19 (3' 10")	1.13 (3' 8")	1.06 (3' 5")	0.88 (2' 10")
	2-38 x 184 (2 x 8)	1.63 (5' 4")	1.53 (5' 0")	1.44 (4' 8")	1.33 (4' 4")	1.25 (4' 1")	1.05 (3' 5")
	2-38 x 235 (2 x 10)	1.99 (6' 6")	1.87 (6' 1")	1.72 (5' 8")	1.60 (5' 2")	1.50 (4' 11")	1.27 (4' 1")
	2-38 x 286 (2 x 12)	2.31 (7' 6")	2.12 (6' 11")	1.96 (6' 5")	1.82 (5' 11")	1.71 (5' 7")	1.45 (4' 9")
Roof, Ceiling and 3 Storeys (3) (6) (7)	2-38 x 89 (2 x 4)	0.88 (2' 10")	0.83 (2' 8")	0.80 (2' 7")	0.77 (2' 6")	0.74 (2' 5")	0.59 (1' 11")
	2-38 x 140 (2 x 6)	1.25 (4' 1")	1.19 (3' 10")	1.16 (3' 8")	1.08 (3' 6")	1.02 (3' 4")	0.81 (2' 7")
	2-38 x 184 (2 x 8)	1.52 (4' 11")	1.44 (4' 8")	1.35 (4' 5")	1.27 (4' 1")	1.21 (3' 11")	0.97 (3' 2")
	2-38 x 235 (2 x 10)	1.86 (6' 1")	1.73 (5' 8")	1.62 (5' 3")	1.53 (5' 0")	1.45 (4' 9")	1.17 (3' 10")
	2-38 x 286 (2 x 12)	2.11 (6' 11")	1.96 (6' 5")	1.84 (6' 0")	1.74 (5' 8")	1.66 (5' 5")	1.35 (4' 5")

Notes:

(1) Where structural sheathing is used, lintel spans may be increased by 15%. Structural sheathing consists of a minimum 9.5 mm (1/3") thick structural panel conforming to CSA O121-M, CSA O151, CAN/CSA-O325.0 or CSA O437.0 fastened with at least two rows of fasteners to the exterior face of the lintel, an a single row to the top plates and studs. Fasteners shall conform to Table 9.23.3.5.

(2) A single piece of 89 mm (3-1/2") thick lumber may be used in lieu of 2 pieces of 38 mm (1-1/2") thick lumber on edge.

(3) If floor joists span the full width of the building without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 storey", by 20% for "Roof, ceiling and 2 storeys", and by 25% for "Roof, ceiling and 3 storeys".

(4) For ends of lintels fully supported by walls, provide minimum bearing length of 38 mm (1-1/2") for lintel spans up to 3 m (9' 8"), or minimum bearing length of 76 mm (3") for lintel spans greater than 3 m (9' 8").

(5) Spans for 0.6 m (24") tributary width are calculated for lintels in end walls that support only a 0.6 m (24") width of roof and ceiling, but do not support roof joists, roof rafters, or roof trusses.

(6) Lintel spans are calculated based on a maximum floor joist, roof joist or rafter span of 4.9 m (16' 0") and a maximum roof truss span of 9.8 m (32' 2"). Spans may be increased by 10% if rafter and joist spans are not more than 3.7 m (12' 1")and roof trusses are not more than 7.4 m (24' 3").

(7) Spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load does not exceed that specified for residential areas as described in Table 4.1.5.3.

Figure 7.14
Lintels With Non-Structural Sheathing - Exterior and Interior Walls

(9.23.12.3.(1))
(9.23.12.3.(3))

Maximum Spans for Spruce - Pine - Fir Lintels - No. 1 or No. 2 Grade - Structural Sheathing

Lintel Supporting	Lintel Size mm (in)(5)	Maximum Span (1) (2) (3) (4) m (ft-in)				
		Specified Snow Load, kPa (psf)				
		1.0 (20.9)	1.5 (31.3)	2.0 (41.8)	2.5 (52.2)	3.0 (62.7)
Roof and Ceiling Only	2 - 38 x 89 (2 x 4)	1.40 (4' 7")	1.23 (4' 0")	1.1 (3'17")	1.03 (3' 4")	0.97 (3' 2")
	2 - 38 x 140 (2 x 6)	2.21 (7' 3")	1.93 (6' 3")	1.73 (5' 8")	1.57 (5' 1")	1.45 (4' 9")
	2 - 38 x 184 (2 x 8)	2.75 (9' 0")	2.36 (7' 8")	1.10 (3' 7")	1.92 (6' 3")	1.77 (5' 9")
	2 - 38 x 235 (2 x 10)	3.36 (11' 0")	2.89 (9' 5")	2.57 (8' 5")	2.34 (7' 8")	2.16 (7' 1")
	2 - 38 x 286 (2 x 12)	3.90 (12' 9")	3.35 (10' 11")	2.99 (9' 9")	2.72 (8' 11")	2.51 (8' 2")
Roof, Ceiling and 1 storey(6)	2 - 38 x 89 (2 x 4)	1.16 (3' 9")	1.08 (3' 6")	1.01 (3' 3")	0.96 (3' 1")	0.92 (3' 0")
	2 - 38 x 140 (2 x 6)	1.74 (5' 8")	1.60 (5' 2")	1.48 (4' 10")	1.39 (4' 6")	1.32 (4' 3")
	2 - 38 x 184 (2 x 8)	2.12 (6' 11")	1.95 (6' 4")	1.81 (5' 11")	1.69 (5' 6")	1.60 (5' 2")
	2 - 38 x 235 (2 x 10)	2.59 (8' 5")	2.38 (7' 9")	2.21 (7' 3")	2.07 (6' 9")	1.93 (6' 3")
	2 - 38 x 286 (2 x 12)	3.01 (9' 10")	2.76 (9' 0")	2.56 (8' 4")	2.38 (7' 9")	2.19 (7' 2")
Roof, Ceiling and 2 storeys (6)	2 - 38 x 89 (2 x 4)	1.09 (3' 6")	1.03 (3' 4")	0.97 (3' 2")	0.92 (3' 0")	0.88 (2' 10")
	2 - 38 x 140 (2 x 6)	1.56 (5' 1")	1.47 (4' 9")	1.39 (4' 6")	1.32 (4' 3")	1.26 (4' 1")
	2 - 38 x 184 (2 x 8)	1.90 (6' 2")	1.79 (5' 10")	1.69 (5' 6")	1.61 (5' 3")	1.51 (4' 11")
	2 - 38 x 235 (2 x 10)	2.33 (7' 7")	2.19 (7' 2")	2.07 (6' 9")	1.94 (6' 4")	1.81 (5' 11")
	2 - 38 x 286 (2 x 12)	2.70 (8' 10")	2.54 (8' 3")	2.37 (7' 9")	2.20 (7' 2")	2.05 (6' 8")
Roof, Ceiling and 3 storeys(6)	2 - 38 x 89 (2 x 4)	1.02 (3' 4")	0.97 (3' 2")	0.93 (3' 0")	0.89 (2' 11")	0.86 (2' 9")
	2 - 38 x 140 (2 x 6)	1.46 (4' 9")	1.39 (4' 6")	1.33 (4' 4")	1.28 (4' 2")	1.23 (4' 0")
	2 - 38 x 184 (2 x 8)	1.78 (5' 10")	1.69 (5' 6")	1.62 (5' 3")	1.54 (5' 0")	1.46 (4' 9")
	2 - 38 x 235 (2 x 10)	2.17 (7' 1")	2.07 (6' 9")	1.96 (6' 5")	1.84 (6' 0")	1.74 (5' 8")
	2 - 38 x 286 (2 x 12)	2.52 (8' 3")	2.38 (7' 9")	2.22 (7' 3")	2.09 (6' 10")	1.98 (6' 5")

(1) Where structural sheathing is used, lintel spans may be increased by 15%. Structural sheathing consists of a minimum 9.5 mm (1/3") thick structural panel conforming to CSA O121-M, CSA O151, CAN/CSA-O325.0 or CSA O437.0 fastened with at least two rows of fasteners to the exterior face of the lintel, an a single row to the top plates and studs. Fasteners shall conform to Table 9.23.3.5.
(2) Lintel spans are calculated based on a maximum floor joist, roof joist or rafter span of 4.9 m (16' 0") and a maximum roof truss span of 9.8 m (32' 2"). Spans may be increased by 10% if rafter and joist spans are not more than 3.7 m (12' 1")and roof trusses are not more than 7.4 m (24' 3").
(3) If floor joists span the full width of the building without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 storey", by 20% for "Roof, ceiling and 2 storeys", and by 25% for "Roof, ceiling and 3 storeys".
(4) For ends of lintels fully supported by walls, provide minimum bearing length of 38 mm (1-1/2") for lintel spans up to 3 m (9' 8"), or minimum bearing length of 76 mm (3") for lintel spans greater than 3 m (9' 8").
(5) A single piece of 89 mm (3-1/2") thick lumber may be used in lieu of 2 pieces of 38 mm (1-1/2") thick lumber on edge.
(6) Spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load does not exceed that specified for residential areas as described in Table 4.1.6.3.

Note:
All imperial values are based on hard conversion of metric span values based on 305 mm (12"), 406 mm (16"), and 610 mm (24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Figure 7.15
Lintels With Structural Sheathing - Exterior Walls

(9.23.12.3.(1))
(9.23.12.3.(3))

WALL FRAMING NAILING

The nailing requirements for wall framing members are summarized in Figure 7.16.

Where the wall plate or sole plate of an exterior wall is not nailed to the joists or to floor blocking, the wall can be fastened to the floor framing by nailing or stapling the exterior wall sheathing (plywood, waferboard or OSB) to the floor framing. Nailing and stapling of sheathing must conform to Figure 7.17.

Nailing for Wall Framing

Construction Detail	Minimum Length Nails	Min. Number or Max. Spacing of Nails
Stud to wall plate (each end) toe nail	63 mm (2-1/2")	4
or end nail	82 mm (3-1/4")	2
Doubled studs at openings, or studs at walls or wall intersections and corners	76 mm (3")	750 mm (30") o.c.
Doubled top wall plates	76 mm (3")	600 mm (23-5/8") o.c.
Bottom wall plate or sole plate to joists or blocking (exterior walls)*	82 mm (3-1/4")	400 mm (15-3/4") o.c.
Interior walls to framing or subflooring	82 mm (3-1/4")	600 mm (23-5/8") o.c.
Horizontal member over openings in non-loadbearing walls - each end	82 mm (3-1/4")	2
Lintels to studs	82 mm (3-1/4")	2 at each end

* See Sentence 9.23.3.4.(2)

Figure 7.16
Nailing for Wall Framing (9.23.3.4.)

Fasteners for Sheathing and Subflooring

Element	Minimum Length of Fasteners for Sheathing and Subfloor Arrachment, mm (in)				Min. Numberor Max. Spacingof Fasteners
	Common or Spiral	Ring Thread Nails and Screws	Roofing Nails	Staples	
Plywood, waferboard or OSB up to 10 mm (3/8") thick	51 mm (2")	45 mm (1-3/4")	N/A	38 mm (1-3/8")	150 mm (5-7/8") o.c. along edges and 300 mm (11-3/4") o.c. along intermediate supports
Plywood, waferboard or OSB from 10 to 20 mm (3/8" to 13/16") thick	51 mm (2")	45 mm (1-3/4")	N/A	51 mm (2")	
Plywood, waferboard or OSB 20 mm (13/16") thick	57 mm (2-1/4")	51 mm (2")	N/A	N/A	
Fibreboard sheathing up to 13 mm (1/2") thick	N/A	N/A	44 mm (1-3/4")	28 mm (1-1/8")	
Gypsum sheathing up to 13 mm (1/2") thick	N/A	N/A	44 mm (1-3/4")	N/A	
Board lumber 184mm (7-1/4") or less wide	51 mm (2")	45 mm (1-3/4")	N/A	51 mm (2")	2 per support
Board lumber more than 184 mm (7-1/4") wide	51 mm (2")	45 mm (1-3/4")	N/A	51 mm (2")	3 per support

Figure 7.17
Fasteners for Sheathing and Subflooring (9.23.3.5.)

Sheathing, Bracing, and Building Paper

All buildings are subjected to racking forces from wind and other loads. As a result bracing must be provided in all cases. Bracing can take the form of:

- diagonal framing,
- cladding or sheathing, or
- an interior finish.

A barrier to the entry of wind driven rain must be provided to all buildings. Building paper and/or sheathing can be used for this purpose. There are no minimum sheathing thickness requirements when the sheathing is only used as a weather barrier. However, if it also provides support for exterior finishes, it must meet the thickness provisions identified in the Code.

Oriented Strand Board and Waferboard

Oriented strand board (OSB) and waferboard are composed of wafers or strands sliced from whole logs in the direction of the grain. The material tree strength is maintained in the resulting panel. The wafers or strands, are dried, mixed with waterproof exterior type binders, formed into a mat or pad and pressed under high heat and pressure into a homogenous structural panel.

Oriented strand board is a type or special form of waferboard. The panel is made the same way, only that the strands are more longitudinal in shape than rectangular. The strands are oriented in layers during the forming process so that they lay in the direction of the panel's longest length. The inner layers may be randomly oriented and/or cross aligned (like plywood). OSB has greater strength in the long direction of the panel. These panels must be applied with the long direction across the support. There are two oriented grades, O-1 and O-2, with the O-2 grade having the greater strength and stiffness.

Waferboard may have three or four layers depending on the complexity of the forming process. The wafers are generally rectangular in shape, randomly oriented and placed randomly. Waferboard panel strength is equal in all directions and the panels may be applied parallel or perpendicular to supports. Randomly oriented waferboard is designated R-1.

The ability of product to meet performance requirements of a given end use is shown on the panel by a PANEL MARK. This panel mark consists of an end use mark - 1F, 2F, 1R, 2R, and W - and a span mark - 16, 20, 24, 32, 40, or 48. The "F", "R" and "W" indicate floor, roof, and wall sheathing respectively. The "1" identifies the panels that, used alone, meet the structural requirements for the end use. The "2" indicates panels that require an additional support element. The two digit span marks are derived from imperial/inch measurements of the span (e.g. "16" indicates a maximum span of 16" (406 mm)).

Panels may qualify for more than one end use (e.g. a panel may be marked 1R24, 2F16, W24).

(Refer to CSA 0437)

Wall Sheathing

Sheathing is required on exterior walls and gable ends when the exterior cladding requires solid backing or when the cladding requires fastening between wall framing member supports.

Wall sheathing can be used to brace the building against wind and other superimposed forces. Equivalent systems, including the use of wall bracing and sheathing papers can achieve results similar to the use of sheathing. Some of these alternatives are detailed below.

When wall sheathing is required, it must conform to the standards that are outlined in Figure 7.18 or 7.19.

The ends of lumber wall sheathing must be supported by framing members or blocking. The joints of the sheathing must be staggered. Figure 7.20 shows typical approaches to the attachment of siding.

The vertical joints of panel-type sheathing must be staggered when the sheathing is installed horizontally. In addition, a gap of not less than 2 mm (approx 3/32") must be provided between panel edges.

Rating For Wall Sheathing When Applying CAN/CSA-O325.0

Maximum Spacing of Supports	Panel Mark
406 mm (16")	W16
508 mm (20")	W20
610 mm (24")	W24

Figure 7.19
Rating of Wall Sheathing (9.23.16.2.)

Wall Sheathing Thickness and Specifications

Type of Material	Minimum Thickness in mm (in)		Material Standards
	with supports at 406 mm (15-3/4") o.c.	with supports at 610 mm (23-5/8") o.c.	
lumber	17.0 (11/16")	17.0 (11/16")	see Table 9.3.2.1 of the Code
fibreboard (insulating)	9.5 (3/8")	11.1 (7/16")	CAN/ULC-S706
gypsum sheathing	9.5 (3/8")	12.7 (1/2")	CSA A82.27, ASTM C79, C1177, C1396
plywood (exterior type)	6.0 (1/4")	7.5 (5/16")	CSA 0121, 0151, 0153
OSB, O-2 grade	6.0 (1/4")	7.5 (5/16")	CSA O437
OSB, O-1 grade, waferboard, R-1 grade	6.35 (1/4")	7.9 (5/16")	CSA O437
polystyrene types 1 and 2	38 (1-1/2")	38 (1-1/2")	CAN/ULC-S701
polystyrene types 3 and 4	25 (1")	25 (1")	CAN/ULC-S701
polyurethane and polyisocyanurate type 1 faced	38 (1-1/2")	38 (1-1/2")	CAN/ULC-S704
polyurethane and polyisocyanurate type 2 and 3 faced	25 (1")	25 (1")	CAN/ULC-S704
phenolic, faced	25 (1")	25 (1")	CAN/CGSB-51.25-M
rigid board mineral fibre, type 2	25 (1")	25 (1")	CAN/ULC-S702

Notes to Table: See Sentences 9.27.5.1.(2) and (4)

Figure 7.18
Wall Sheathing Thickness and Specifications (9.23.16.2.)

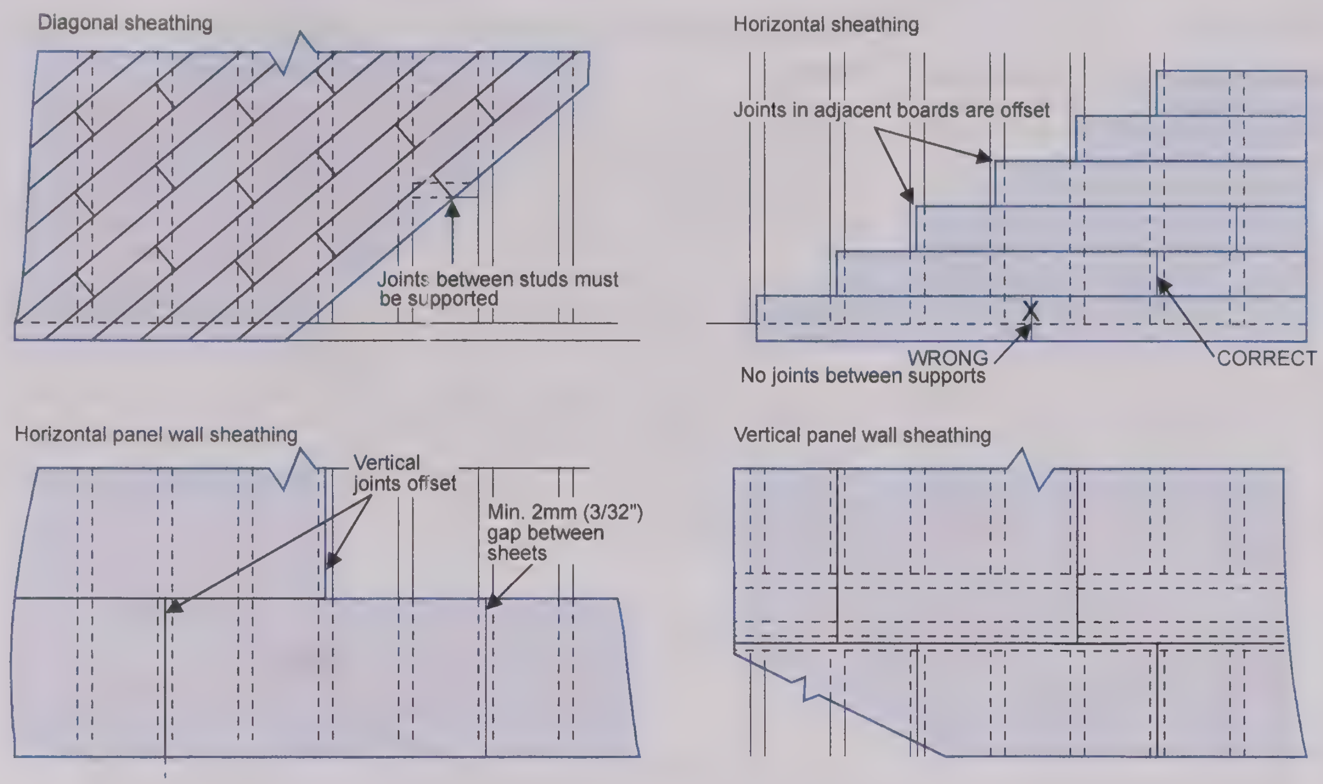


Figure 7.20
Support of Sheathing Joints

(9.23.16.4.)
(9.23.16.5.)

Sheathing Membrane

At least one layer of sheathing membrane must be installed beneath siding, stucco or masonry veneer. Sheathing membrane used in dwelling units must conform to the performance requirements of CAN/CGSB-51.32, "Sheathing, Membrane, Breather Type". It must be lapped at least 100 mm (4") and if it is applied horizontally, the upper sheets must overlap the lower sheets.

Two layers of wall sheathing membrane can be used instead of wall sheathing if the walls of the building are suitably braced. In this instance, the joints in the sheathing membrane must be supported by framing beneath. The membrane must be nailed with roofing nails or staples spaced not more than 150 mm (5-7/8") apart along the edges of the outer layer of sheathing membrane.

Sheathing can be used to replace one layer of membrane. There is no need for the wall sheathing used in this case to conform to the wall sheathing thickness requirements of Figure 7.18. These minimum thickness provisions must be adhered to, however, where the sheathing also provides support for an exterior finish or where the cladding requires fastening between wall framing supports.

Sheathing membrane may be omitted entirely if the joints in the siding which is chosen can effectively prevent the passage of wind and rain through the wall assembly. Acceptable alternatives include using plywood, hardboard, OSB, waferboard or fibre cement siding installed with edges supported by the wall framing and where all vertical and horizontal joints between adjacent sheets are sealed and made weathertight.

Sheathing membrane can also be omitted beneath metal siding with locked seam type joints. Common siding materials are not of this type.

Wall Bracing

Bracing can be provided to each exterior wall in each storey of the dwelling unit by at least one diagonal 19 mm by 89 mm (1 x 4) brace installed at 45° to the horizontal, extending the full height of the wall on each storey, nailed to each stud and wall plate with not less than two 63 mm (2-1/2") nails. Often metal "T" bracing is used.

Bracing as described above is not required if the interior finish of the dwelling unit conforms to the provisions of the Code as outlined in Chapter 14 or if the walls are clad with a panel type siding, diagonal lumber, plywood, waferboard, OSB, gypsum or fibreboard sheathing.

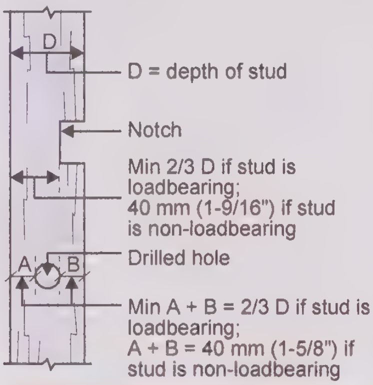
Notching and Drilling of Framing Members

Wall studs can be notched and drilled within established limits. No more than 1/3 of the depth of the stud can be drilled or notched if the stud is loadbearing. At least 40 mm (1-9/16") of stud must remain undamaged if the stud is non-loadbearing. Larger notches and holes are possible if the stud is suitably reinforced.

Top plates can be notched and drilled provided the undamaged width of top plates is not less than 50 mm (2"). Reinforcing the top plate can allow larger notches and holes to be used where necessary. See Figures 7.21 and 7.22.

Reinforcement for Future Grab Bar Installation

Wall reinforcement is required for wood stud walls enclosing a main bathroom in a dwelling unit to permit the future installation of a grab bar. The same requirements apply to steel stud walls. Grab bar reinforcement must be installed on a wall adjacent to a water closet and a shower or bathtub where wall studs are used to enclose the main bathroom to permit the future installation of grab bars. The main bathroom in a house refers to the common bathroom and not a powder room or ensuite. Refer to Figure 7.23 for more details.



Maximum Size of Notch or Drill Hole

Stud	Loadbearing	Non-loadbearing
38 x 89 mm (2 x 4)	30 mm (1-1/8")	48 mm (1-7/8")
38 x 140 mm (2 x 6)	46 mm (1-3/4")	98 mm (3-7/8")

Figure 7.21
Notching of Wall Studs (9.23.5.3.)

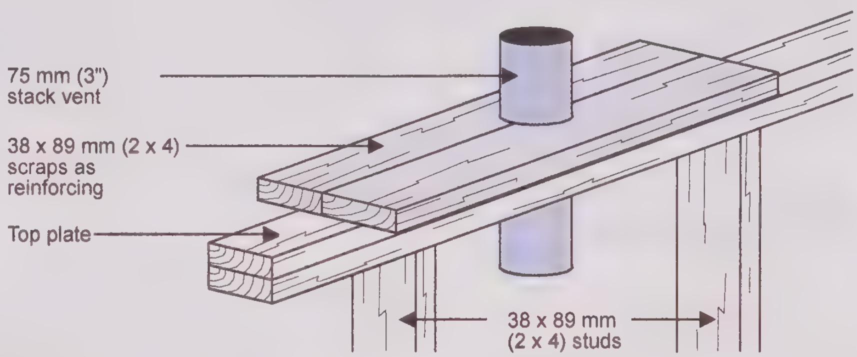


Figure 7.22
Notching of Top Plate (9.23.5.4.)

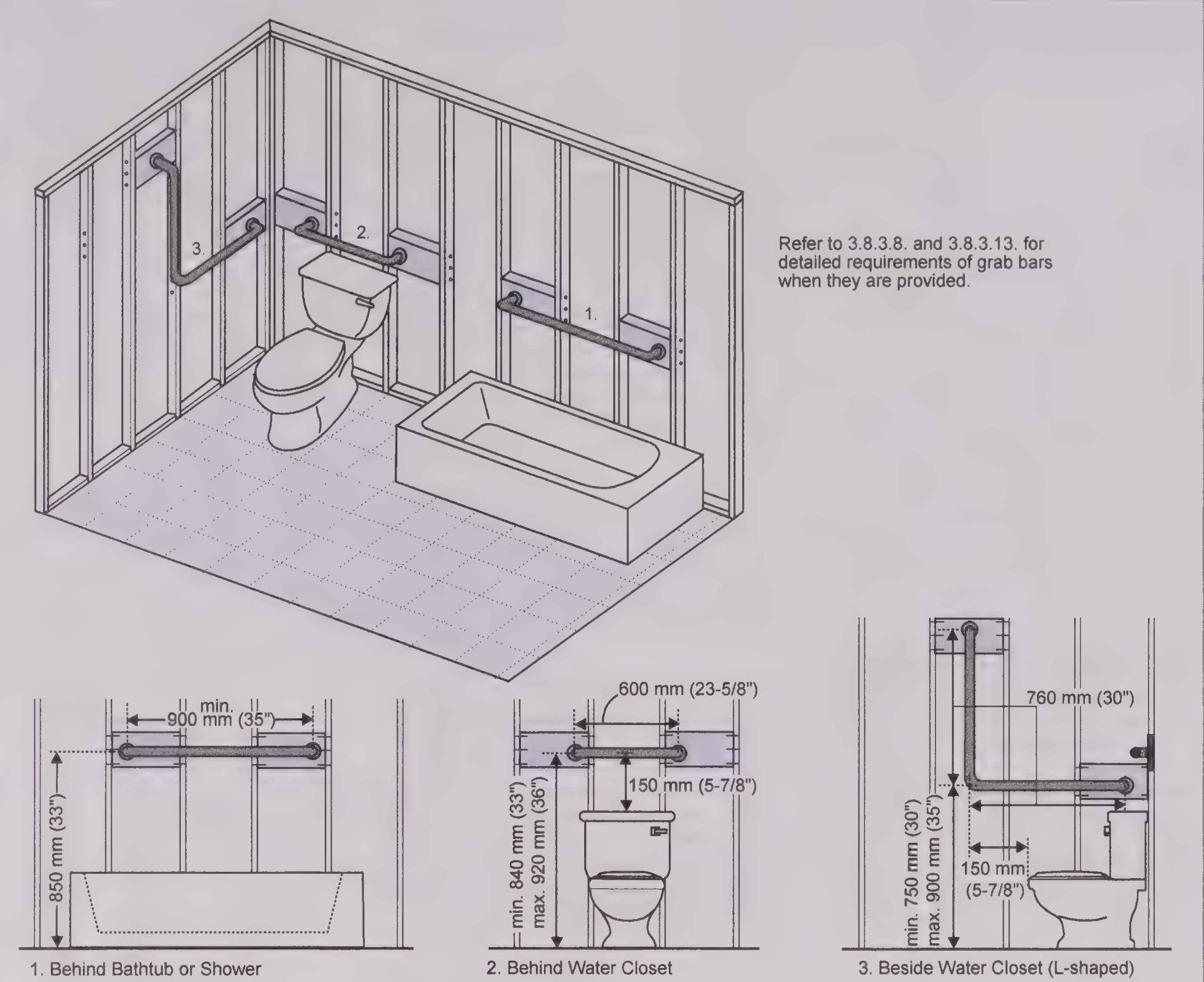


Figure 7.23
Reinforcement for Future Installation for Grab bars

(9.5.2.3.)

STEEL STUD WALL CONSTRUCTION

BUILDING CODE REFERENCES

DIVISION B

9.5.2.3.	Stud Wall Reinforcement
9.24.1.1.	Application
9.24.1.2.	Material Standards
9.24.1.3.	Metal Thickness
9.24.1.4.	Screws
9.24.1.5.	Cladding, Sheathing and Interior Finish Required
9.24.2.1.	Size and Spacing of Studs in Interior Walls
9.24.2.2.	Thickness of Studs
9.24.2.3.	Runners
9.24.2.4.	Openings in Fire Separations
9.24.2.5.	Size and Spacing of Studs in Exterior Walls
9.24.3.1.	Installation of Runners
9.24.3.2.	Fire-Rated Walls
9.24.3.3.	Orientation of Studs
9.24.3.4.	Support for Cladding Materials
9.24.3.5.	Framing around Openings
9.24.3.6.	Attachment of Studs to Runners
9.24.3.7.	Openings for Fire Dampers

The Code outlines measures for the use of steel studs as framing members for non-loadbearing interior and exterior walls. Part 4 of the Code provides the requirements for loadbearing walls.

All steel stud framing that is used in this type of construction must conform to CAN/CGSB 7.1, "Cold Formed Steel Framing Components" and must be clad on both sides and fastened with screws.

Size of Framing and Installation

Steel studs for interior and exterior non-loadbearing walls must conform to Figure 7.24. Runners for interior and exterior non-loadbearing walls, installed at the tops and bottoms of walls, must be as thick as the studs that are used and must have flanges that are at least 30 mm (1-3/16"). The runner must be attached to the building with 63 mm (2-1/2") nails or 24 mm (1") screws spaced no more than 305 mm (12") apart for exterior walls and not greater than 610 mm (24") for interior walls. The ends of the runner must be attached to the building with a fastener within 50 mm (2") of the end.

Runners must be attached to studs with screws or by crimping or welding to keep the studs in alignment during construction. The studs are installed with webs at right angles to the wall face and extend the full height of the wall.

At openings, studs must be doubled on each side of the opening and tripled if the opening is part of an exterior wall and exceeds 2.4 m (7' 10"). The studs must be tied together to act as a unit. Studs at openings that do not extend the full height of the wall are permitted provided they are tied to runners at the ends, in addition to being tied to full length studs. See Figure 7.25.

Steel studs that are used in walls that are required to have a fire rating must be installed so that a 12 mm (1/2") clearance between the top of the stud and the runner is maintained. This will allow for expansion of the stud in the event of fire. The stud must not be attached to the runner in a way that would prevent it from expanding.

Steel Studs for Non-Loadbearing Walls

	Minimum Stud Size mm (in) 1. interior walls 2. exterior walls	Minimum Metal Thicknesses mm (mil) 1. interior walls 2. exterior walls	Maximum Stud Length, m (ft-in) — Spacing of Studs: 305 mm	406 mm	610 mm
1	30 x 41 (1-3/16 x 1-9/16)	0.46 (18)	-	3.0 (9' 10")	2.7 (8' 10")
	30 x 64 (1-3/16 x 2-1/2)	0.46 (18)	4.4 (14' 5")	4.0 (13' 1")	3.5 (11' 10")
	30 x 89 (1-3/16 x 3-5/8)	0.46 (18)	5.2 (17' 0")	4.6 (15' 1")	4.6 (15' 1")
	30 x 152 (1-3/16 x 6)	0.46 (18)	6.6 (21' 8")	5.8 (19' 0")	4.9 (16' 0")
2	30 x 91 (1-3/16 x 3-5/8)	0.53 (21)	3.0 (9' 10")	2.4 (7' 10")	-
	30 x 91 (1-3/16 x 3-5/8)	0.69 (27)	3.3 (10' 10")	2.7 (8' 10")	2.4 (7' 10")
	30 x 91 (1-3/16 x 3-5/8)	0.85 (33)	3.6 (11' 10")	3.0 (9' 10")	2.7 (8' 10")
	30 x 91 (1-3/16 x 3-5/8)	1.0 (39)	4.0 (13' 1")	3.3 (10' 10")	3.0 (9' 10")

Figure 7.24
Steel Studs for Non-Loadbearing Walls

(9.24.2.1.)
(9.24.2.5.)

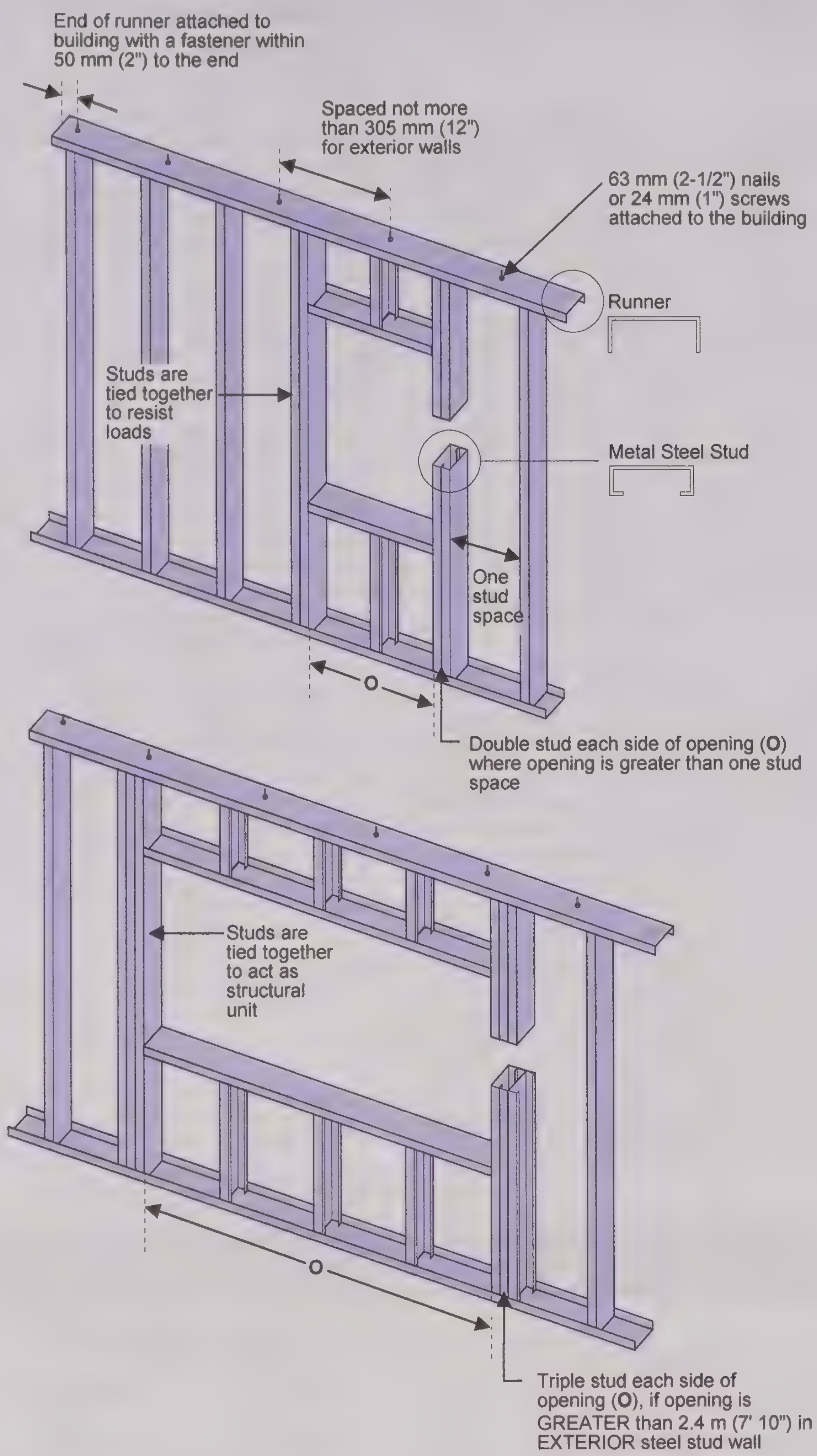


Figure 7.25
Steel Studs at Openings

(9.24.3.5.)

MASONRY AND INSULATING CONCRETE FORMS ABOVE GROUND

BUILDING CODE REFERENCES

DIVISION B

9.20.1.1.	General
9.20.1.2.	Earthquake Reinforcement
9.20.2.1.	Masonry Unit Standards
9.20.2.2.	Used Brick
9.20.2.4.	Cellular Concrete
9.20.2.5.	Stone
9.20.2.6.	Concrete Units Exposed to the Weather
9.20.2.7.	Compressive Strength
9.20.3.1.	Mortar Materials
9.20.3.2.	Mortar and Grout Mixes
9.20.4.1.	Thickness
9.20.4.2.	Solid Masonry Units
9.20.4.3.	Hollow Masonry Units
9.20.5.1.	Masonry Support
9.20.5.2.	Lintels or Arches
9.20.6.1.	Thickness of Exterior Walls
9.20.6.2.	Cavity Walls
9.20.6.5.	Parapet Walls
9.20.7.1.	Maximum Dimensions
9.20.7.2.	Minimum Wall Thickness
9.20.7.3.	Separation of Chases and Recesses
9.20.7.4.	Non-Conforming Chases or Recesses
9.20.7.5.	Chases or Recesses Cut into Walls
9.20.8.1.	Capping of Hollow Masonry Walls
9.20.8.2.	Cavity Walls Supporting Framing Members
9.20.9.1.	Joints to be Offset or Reinforced
9.20.9.2.	Bonding or Tying of Other than Masonry Veneer
9.20.9.3.	Bonding
9.20.9.4.	Tying
9.20.10.1.	Lateral Support Required
9.20.11.2.	Bonding and Tying of Intersecting Walls
9.20.11.3.	Wood Frame Walls Intersecting Masonry Walls
9.20.11.5.	Cornices, Sills and Trim
9.20.12.2.	Corbelling for Cavity Walls
9.20.13.5.	Flashing for Weep Holes in Masonry Veneer/Masonry Walls
9.20.13.8.	Required Weep Holes
9.20.13.9.	Protection of Interior Finish
9.20.13.10.	Mortar Droppings
9.20.14.1.	Laying Temperature of Mortar and Masonry
9.20.14.2	Protection from Weather
9.20.15.1.	Amount of Reinforcement
9.20.15.2.	Installation Standard
9.20.16.1.	Corrosion Resistance of Connectors

A masonry wall's functionality depends on the quality and strength of the type of mortar and the quality of workmanship.

The scope of this section is limited to non-loadbearing, masonry veneer and insulating concrete form walls not in contact with the ground. Masonry veneer walls must not extend more than 11 m (36' 1") above the foundations. Part 4 of the Code must be used for the design of buildings where unreinforced masonry walls support more than one floor or a roof of concrete construction. Flat insulating concrete form walls must have a maximum floor height of 3 m (9' 10") and erected in a single dwelling unit not more than 2 storeys high in a location where the seismic spectral response acceleration S_a (0.2) is not greater than 0.4 as defined in Article 9.20.1.1. of the Code. See the Climatic Design Data in Supplementary Standard SB-1.

Used bricks are permitted in new dwelling units provided they are free of old mortar, soot or other surface coatings and they comply to all new material standards. (Refer to 9.20.2.1. of the Code for a list of all governing standards.) The compressive strength of masonry units must meet the requirements shown in Figure 7.26.

In all cases where masonry is being placed, weather protection must be a consideration. Rain and snow must not be allowed to penetrate masonry through the top of unfinished walls. A waterproof covering is required over all uncompleted masonry when construction is not in progress. See Article 9.20.14.2. in the Code.

Masonry Support

Masonry cracking can often be attributed to inadequate support. When masonry is in contact with the ground, it can crack due to uneven foundation settlement and temperature induced expansion and/or contraction. The weight of masonry construction is unable to accommodate significant movement. Therefore all loadbearing masonry must be supported on masonry, concrete or steel to provide the high compressive load resistance required.

If masonry is used as a supporting wall, it must be at least the same thickness as the wall being supported to reduce the likelihood of stress-related cracks and to transfer the load safely. Cavity walls are limited to a projection of 25 mm (1") beyond the unparged face of foundation walls. Masonry over openings must be supported by steel, reinforced concrete or masonry lintels, or arches. All arches must be designed to Part 4 (9.20.5.2.). These areas are particularly noteworthy since they often represent areas of concentrated loads and stress cracks. Figure 7.27 can be used to select steel angle lintels to support masonry above openings (note: this figure does not apply to masonry veneer).

Compressive Strength of Masonry

Type of Unit	Minimum Compressive Strength over Net Area, MPa (psi)	
	Exposed to Weather	Not Exposed to Weather
Solid or hollow concrete block	15 (2200)	10 (1500)
Solid loadbearing cellular units	Not permitted	5 (730)
Solid non-loadbearing cellular units	Not permitted	2 (290)

Figure 7.26
Compressive Strength of Masonry (9.20.2.7.)

Loose Steel Lintels for Masonry other than Masonry Veneer - No. & Size of Angles Required [7]

Clear Span [1][3]	Exterior Angles, mm (in) – For Brick 100 mm (4") – No Floor Load	Exterior Angles, mm (in) – For Stone 100 mm (4") + 50 mm (2") stone facing – No Floor Load	Wall Thickness mm (in)	Interior Angles, mm (in) – Maximum Floor Loads per Metre (foot) of Span in Newtons (pounds) [2][4][5] – None	3 650 (250)	7 300 (500)	10 950 (750)	14 600 (1000)	18 250 (1250)	21 900 (1500)
1 200 mm (3' - 11") or less	L-90 x 90 x 6	L-125 x 90 x 8	203 (8")	L-90 x 90 x 6	L-90 x 90 x 6	L-90 x 90 x 8	L-100 x 90 x 8	L-125 x 90 x 8	L-125 x 90 x 10	L-125 x 90 x 13
	(L-3-1/2" x 3-1/2" x 1/4")	(L-5" x 3-1/2" x 5/16")	305 (12")	2Ls-90 x 90 x 8	2Ls-90 x 90 x 6	2Ls-90 x 90 x 8	2Ls-90 x 90 x 8	2Ls-90 x 90 x 8	2Ls-100 x 90 x 8	2Ls-100 x 90 x 8
1 500 mm (4' 11")	L-90 x 90 x 8	L-125 x 90 x 8	203 (8")	L-90 x 90 x 8	L-90 x 90 x 8	L-125 x 90 x 8	L-125 x 90 x 10	L-125 x 90 x 13	L-150 x 100 x 10	-
	(L-3-1/2" x 3-1/2" x 5/16")	(L-5" x 3-1/2" x 5/16")	305 (12")	2Ls-90 x 90 x 8	2Ls-90 x 90 x 8	2Ls-90 x 90 x 8	2Ls-125 x 90 x 8	2Ls-125 x 90 x 8	2Ls-125 x 90 x 8	2Ls-125 x 90 x 10
1 800 mm (5' 11")	L-100 x 90 x 8	L-125 x 125 x 8	203 (8")	L-100 x 90 x 8	L-125 x 90 x 8	L-125 x 90 x 10	L-150 x 100 x 10	-	-	-
	(L-4" x 3-1/2" x 5/16")	(L-5" x 5" x 5/16")	305 (12")	2Ls-100 x 90 x 8	2Ls-100 x 90 x 8	2Ls-125 x 90 x 8	2Ls-125 x 90 x 8	2Ls-125 x 90 x 10	2Ls-150 x 100 x 10	2Ls-150 x 100 x 10
2 100 mm (6' 11")	L-100 x 90 x 6	L-125 x 125 x 8	203 (8")	L-100 x 90 x 8	L-125 x 90 x 10	L-150 x 100 x 10	-	-	-	-
	(L-4" x 3-1/2" x 5/16")	(L-5" x 5" x 5/16")	305 (12")	2Ls-100 x 90 x 8	2Ls-125 x 90 x 10	2Ls-125 x 90 x 10	2Ls-150 x 100 x 10	2Ls-150 x 100 x 10	-	-
2 400 mm (7' 10")	L-125 x 90 x 8	L-125 x 125 x 8	203 (8")	L-125 x 90 x 8	L-150 x 100 x 10	-	-	-	-	-
	(L-5" x 3-1/2" x 5/16")	(L-5" x 5" x 5/16")	305 (12")	2Ls-125 x 90 x 8	2Ls-125 x 90 x 13	2Ls-150 x 100 x 10	-	-	-	-
2 700 mm (8' 10")	L-125 x 90 x 10	L-125 x 125 x 10	203 (8")	L-125 x 90 x 10	-	-	-	-	-	-
	(L-5" x 3-1/2" x 3/8")	(L-5" x 5" x 3/8")	305 (12")	2Ls-125 x 150 x 10	2Ls-150 x 100 x 10	-	-	-	-	-
3 000 mm (9' 11")	L-150 x 100 x 10	L-125 x 125 x 13	203 (8")	L-150 x 100 x 10	-	-	-	-	-	-
	(L-6" x 4" x 3/8")	(L-5" x 5" x 1/2")	305 (12")	2Ls-150 x 100 x 10	-	-	-	-	-	-

Notes
(1) 150 mm (5-7/8") min. bearing required for all lintels.
(2) Omit floor load in lintel when distance to bottom of floor construction is greater than width of opening.
(3) Interior and exterior angles in 200 mm (7-7/78") walls and interior angles in 300 mm (11-3/4") walls are bolted together when clear span is over 1800 mm (5' 11").
(4) When masonry lighter than brick is used over interior angles floor load may be increased by the difference in weight per sq. m times the width of the opening. Note generally available.
(5) Interior angles have been designed for floor load plust brick masonry of height equal to width of opening.
(6) Allowable flexural stress = 138 MPa (20 000 psi). Deflection maximum = 1/700 span.
(7) The figures in the Table indicating wall thickness and angle cross-section are in mm (in).

See Steel Lintels Supporting Masonry Veneer - Chapter 15

Table 7.27
Loose Steel Lintels for Masonry other than Masonry Veneer - No. & Size of Angles (9.20.5.2.)

Masonry walls must be supported laterally at right angles to the wall by floor or roof systems, intersecting masonry walls or buttresses. In general, the spacing of this support depends on the thickness of the wall. For loadbearing and exterior non-loadbearing walls, the spacing of the lateral supports for the wall can be no greater than 20 times the wall thickness. For interior non-loadbearing walls the support requirements are less restrictive at 36 times the wall thickness. The wall thickness for cavity walls is defined as two-thirds the sum of the thickness of the wythes. Refer to Figure 7.28.

Intersecting walls which provide lateral support can be anchored or bonded to the supported wall by masonry or corrosion resistant metal ties. Figure 7.29 illustrates two alternatives to anchoring walls which provide lateral support to masonry walls. Wood frame walls can provide lateral support if tied to the wall with corrosion resistant steel rods spaced not more than 900 mm (2' 11") vertically.

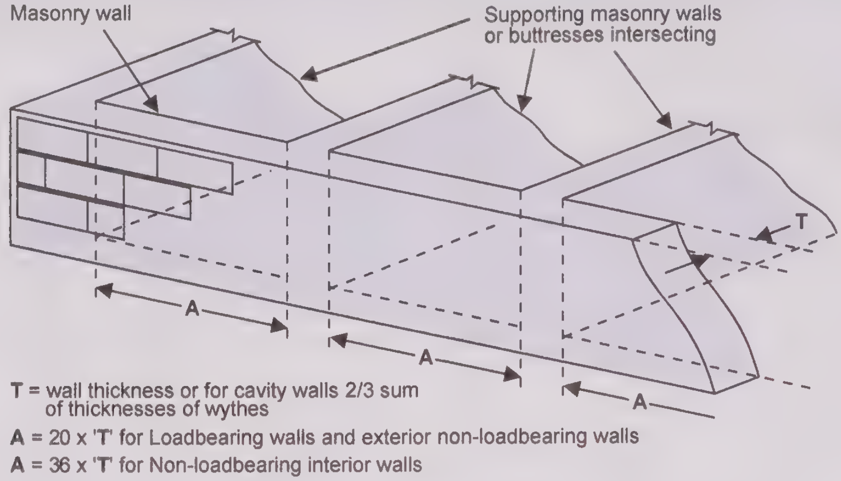


Figure 7.28
Lateral Support (9.20.10.1.)

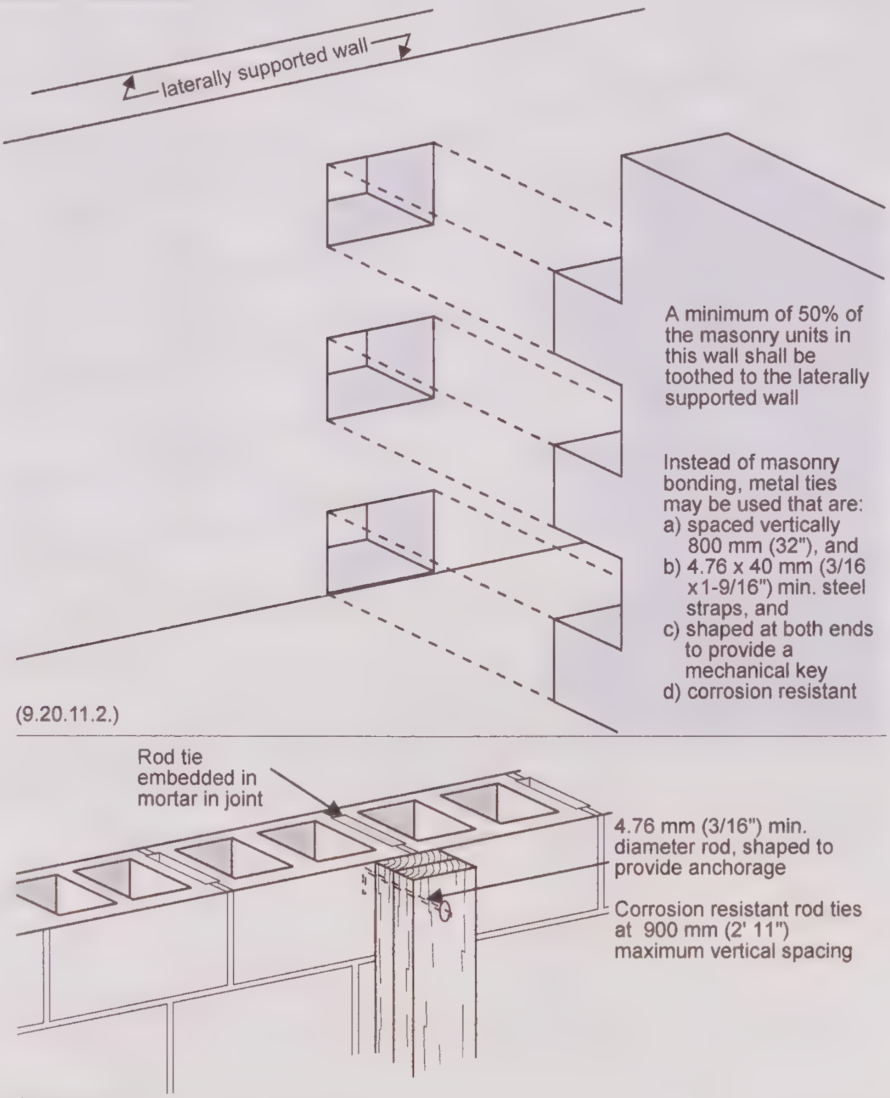


Figure 7.29
Intersecting Walls Providing Lateral Support (9.20.11.3.)

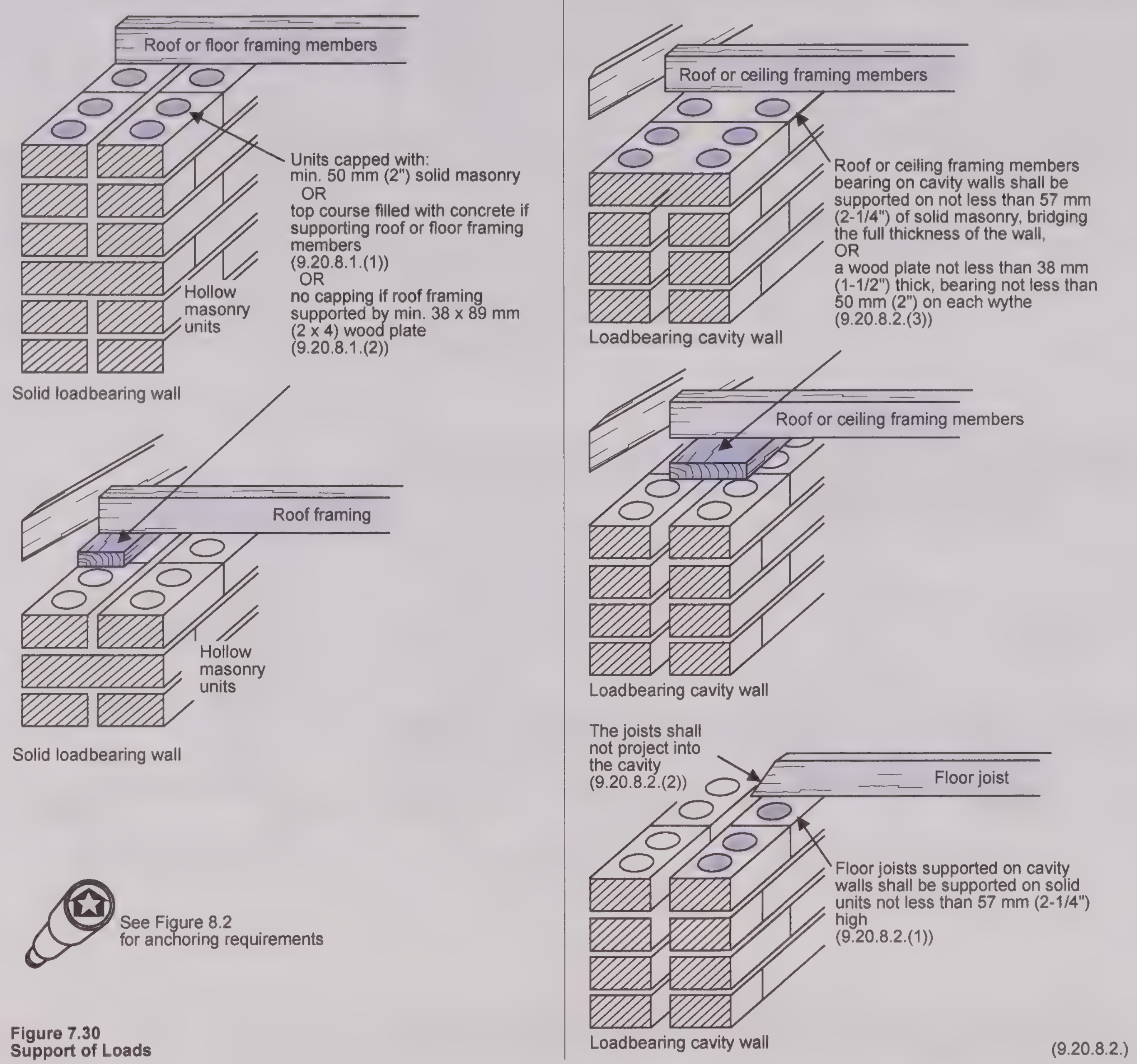


Figure 7.30
Support of Loads

Support of Loads

Framing members must bear on solid masonry or concrete-filled hollow masonry units to adequately transfer load. In loadbearing cavity walls, to prevent collapse of the wall during fire, floor joists must bear only on the inner wythe of masonry and should not project into the cavity.

Roof and ceiling framing, however, must bear on both wythes or on a wood plate not less than 38 mm (2" nominal) thick and bearing not less than 50 mm (2") on each wythe. Both floor and roof or ceiling framing member must bear on solid masonry units no less than 57 mm (2-1/4") high as illustrated in Figure 7.30.

Thickness and Height

The thickness of exterior masonry walls other than cavity walls is specified for walls not more than 2.8 m (9' 2") in unsupported height. The wall thickness which is required depends on the number of storeys which are supported and is illustrated in Figure 7.31.

Figure 7.32 shows the Code requirement for cavity wall thickness.

Interior non-loadbearing walls must be not less than 65 mm (2-1/2") thick while the thickness of loadbearing interior walls is calculated based on the spacing of the lateral support provided.

The wall thickness can be no less than 1/20 of the spacing between supports and in general should not be less than 140 mm (6") thick.

Parapet walls must be solid from the top of the parapet to at least 300 mm (11-3/4") below the adjacent roof level. Their height can be not more than three times the parapet wall thickness.

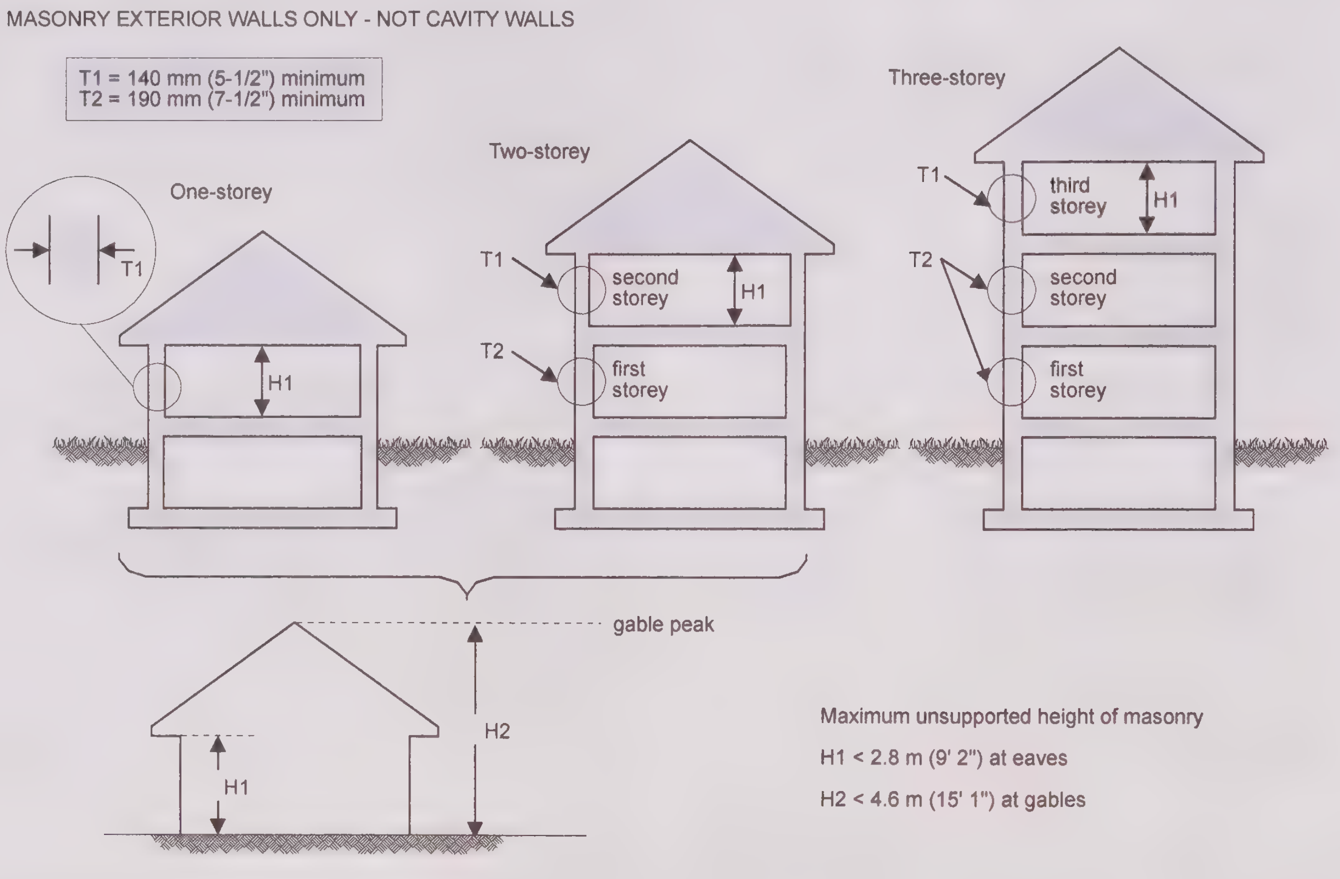
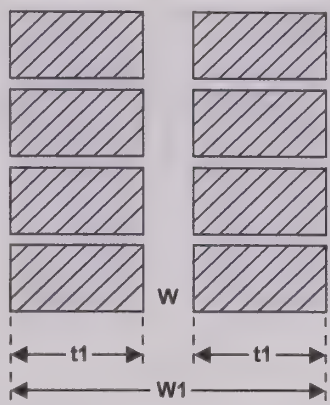


Figure 7.31
The Thickness of Masonry Walls (9.20.6.1.)

Mortar and Grout Mixes

Cement and aggregates used for mortar and grout must comply with the standards referred to in the Code. Figure 7.33 specifies mortar and grout mixes to be used. Water and aggregate must be free of materials that can adversely affect the mortar, including material which may be frozen. For good results and proper curing of the mortar, the masonry and mortar must be maintained at a temperature not below 5 °C (41 °F) during mixing and for not less than 48 hours after installation. Chapter 15, Exterior Finishes provides further discussion.



t1 = 90 mm (3-1/2") min. if joints are raked

t1 = 75 mm (3") min. if joints are not raked

W = 50 mm (2") min. and 150 mm (5-7/8") max. with metal ties

W1 = 230 mm (9") min. for top 7.6 m (24' 11") of wall and 330 mm (13") min for the rest

Note:
W1 = 200 mm (8") min. when using 75 mm (3") wythes.

Maximum wall height when using 75 mm (3") wythes is 6 m (19' 8")

Figure 7.32
Cavity Wall Thickness (9.20.6.2.)

Mortar Use

Location	Building Element	Mortar Type
Exterior, above ground	Loadbearing walls and columns	S
	Non-loadbearing walls and columns	N or S
	Parapets, chimneys and masonry veneer	N or S
Interior	Loadbearing walls and columns	N
	Non-loadbearing walls and columns	N

Mortar Mix Proportions (by Volume)

Mortar Type	Portland Cement	Lime	Masonry Cement Type N	Masonry Cement Type S	Fine, Aggregate (damp, loose-state sand)
S	1	1/2	-	-	3-1/2 to 4-1/2
	-	-	-	1	2-1/4 to 3
	1/2	-	1	-	3-1/2 to 4-1/2
N	1	1	-	-	4-1/2 to 6
	-	-	1	-	2-1/4 to 3

Grout Mix Proportions (by Volume)

Portland Cement	Lime	Fine Aggregate (sand)	Coarse Aggregate
1	0 to 1/10	2-1/4 to 3 times the sum of the cement and lime volumes	1 to 2 times the sum of the cement and lime volumes

Figure 7.33
Mortar Use and Grout Mix Proportions (By Volume) (9.20.3.2.)

Mortar Joints

The maximum average mortar joint permitted in dwelling units is 10 mm (3/8") with no joint less than 5 mm (3/16") and no more than 20 mm. Consistent joint thickness ensures a level masonry top course.

Except for head joints left open for weep holes and ventilation, solid masonry units must be laid with full bed and head joints. Hollow units must be laid with mortar applied to head and bed joints of both inner and outer face shells. Vertically aligned webs of hollow masonry must be laid in a full bed of mortar under the starting course, in all courses of columns, and where it is adjacent to cells or cavities that will be filled with grout. See Figure 7.34.

Bonding and Tying

Vertical joints in unit masonry courses must be offset or, alternatively, each wythe must be reinforced with at least 2 corrosion-resistant steel bars 3.76 mm (5/32") in diameter placed horizontally and at vertical intervals not more than 460 mm (18"). Bars must lap one another by at least 150 mm (5-7/8").

Wythes of masonry walls must be tied together by masonry units or bonding ties. Bonding masonry units must extend at least 90 mm (3-1/2") into each wythe and must be spaced not more than 600 mm (23-5/8") vertically and horizontally for brick and 900 mm (2' 11") for block and tile.

Individual rod type masonry ties used in cavity walls must be completely embedded in mortar except for in the cavity and must be staggered from course to course. Other requirements for these ties are illustrated in Figure 7.35.

Where rod type masonry ties are used to bond other types of walls together, the space between the walls must be filled with mortar. The spacing and location requirements for these ties are shown in Figure 7.36.

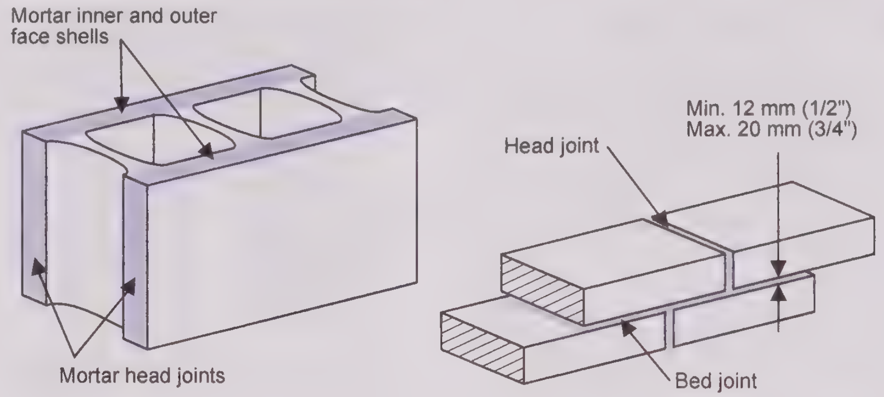
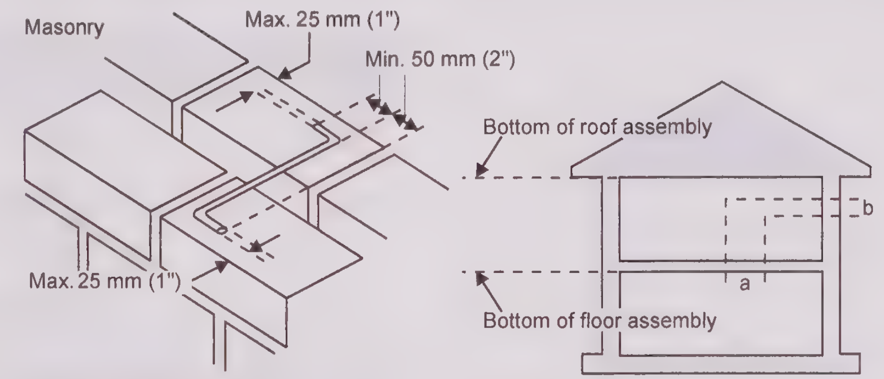


Figure 7.34
Head and Bed Joints
(9.20.4.1.)
(9.20.4.2.)
(9.20.4.3.)

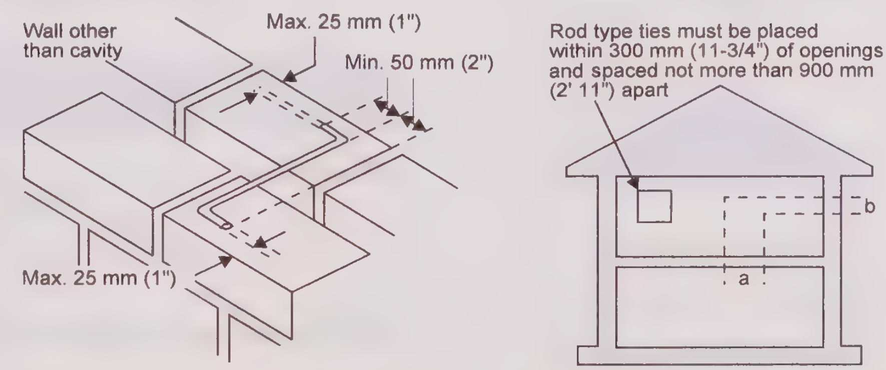


Minimum cross-sectional area of tie 17.8 mm² (0.03 in²) 5 mm (3/16") diameter

Ties must be staggered from course to course

Tie spacing
a = 900 mm (2' 11") max. horizontally
b = 400 mm (15-3/4") max. vertically
except, ties must be placed within 100 mm (4") of bottom of assemblies, where the cavity wall extends below the assembly and spaced 600 mm (23-5/8") horizontally

Figure 7.35
Metal Ties in Cavity Walls (9.20.9.4.)



Minimum cross-sectional area of tie 17.8 mm² (0.03 in²) 5 mm (3/16") diameter

Ties must be staggered from course to course

Tie spacing
a = 900 mm (2' 11") max. horizontally
b = 460 mm (18") max. vertically

Figure 7.36
Metal Ties in Non-Cavity Walls (9.20.9.4.)

Corbelling, Cornices, Sills, and Trim

The prescriptive requirements for cornices, sills and trim are intended to provide adequate support and anchorage to these decorative elements (see Figure 7.37).

Corbelling must not reduce the capacity of walls to transfer loads, nor should it result in stress related spalling of masonry units. The Code requirements as illustrated in Figure 7.38 provide a basis for the proper corbelling of masonry.

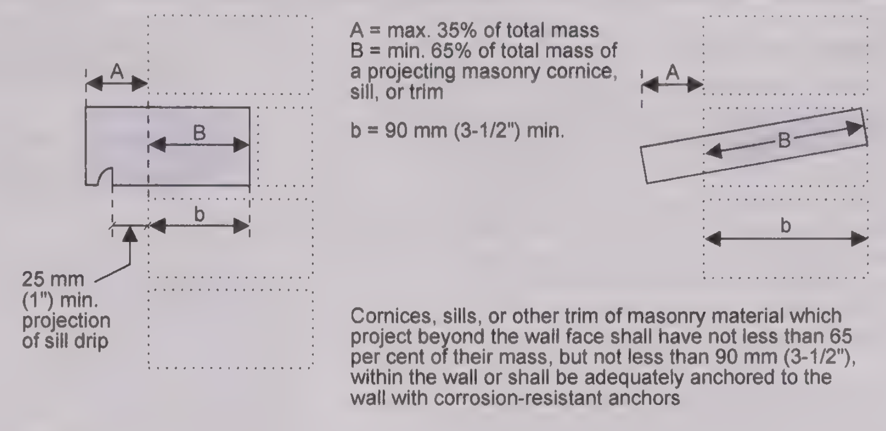


Figure 7.37
Cornices, Sills, and Trim (9.20.11.5.)

Reinforcement for Earthquakes

In areas prone to earthquakes special measures must be incorporated in the construction of masonry walls to resist vibration loads. Loadbearing elements of masonry buildings of two and three storeys, in locations where the seismic spectral response acceleration, S_a (0.2), is greater than 0.55, must be reinforced. In locations where the S_a (0.2) is greater than 0.35 and less than or equal to 0.55, all loadbearing elements of 3 storey buildings must be reinforced. The total area of steel reinforcement required consists of at least 0.002 times the vertical cross-sectional area of the wall. Not less than 1/3 of the total area of required steel must be installed in any one direction (refer to Article 9.20.15.1.).

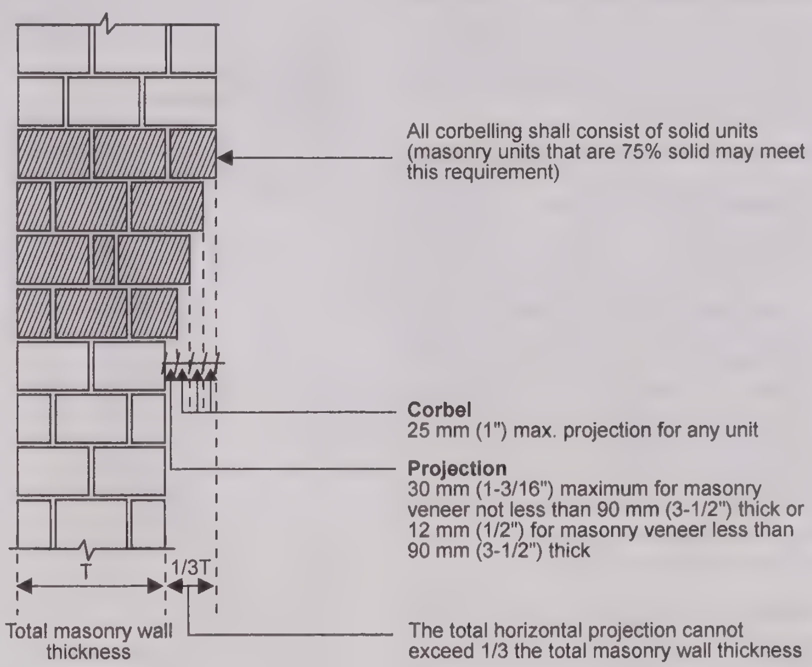


Figure 7.38
Corbelling (9.20.12.)

Chases and Recesses

Chases and recesses are limited in size and location to ensure walls are able to transfer loads adequately. Where chases or recesses fail to meet the limits established by the Code they must be treated as openings in the wall. Appropriate lintels or arches must be provided in these cases to help transfer wall loads to more substantial parts of the wall.

Chases and recesses must not be cut in hollow masonry walls after the units are in place. The limits placed on the size and location of chases and recesses are shown in Figure 7.39. Note that chases and recesses are not permitted in walls less than 190 mm (7-1/2") thick. Recesses may be constructed in walls 190 mm (7-1/2") thick provided they do not exceed the dimensions illustrated.

Control of Rain Water Penetration

The Code provisions for the control of rain penetration for loadbearing masonry walls deal primarily with flashing, weep holes and the protection of interior finishes. Requirements which are intended to control the penetration of rain water in walls are extensive and numerous and are found throughout this Guide. In particular, reference should be made to Chapter 15, Exterior Finishes for more discussion.

Weep holes and flashing must be installed to direct water which penetrates cavity walls to the exterior. Figure 7.40 illustrates the Code requirements. Weep holes and flashing must be installed to direct water which penetrates cavity walls to the exterior. Figure 7.40 illustrates the Code requirements. Mortar droppings within cavity walls must be prevented from forming a bridge within the wall that can prevent water that collects within the cavity from being directed to the exterior. Water that collects in the cavity can potentially damage interior finishes.

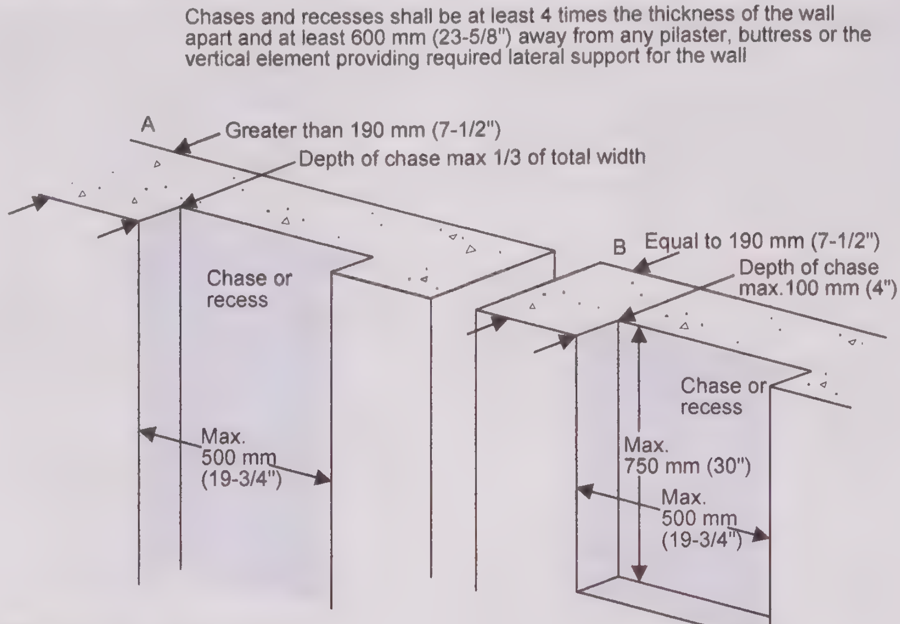


Figure 7.39
Chases and Recesses (9.20.7.)

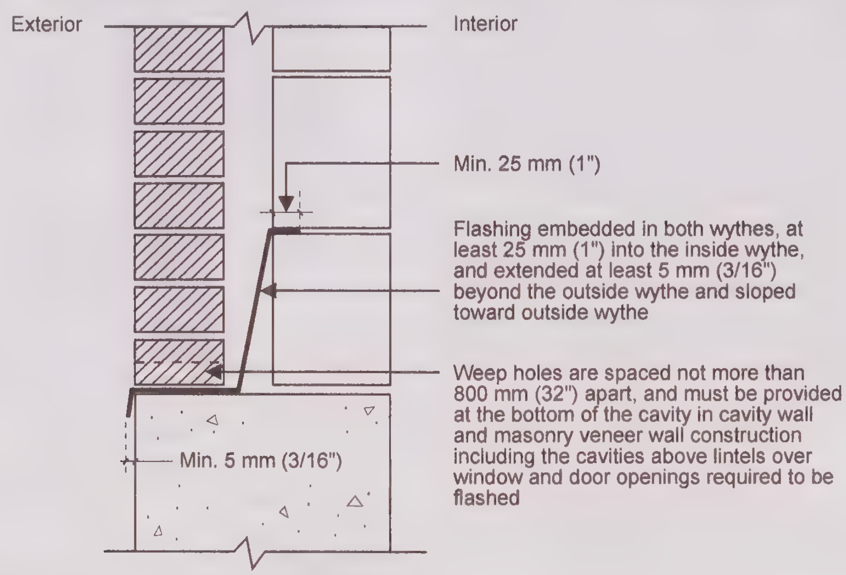


Figure 7.40
Weep Holes (9.20.13.5.) (9.20.13.8.)

In non-cavity walls (i.e. solid masonry walls) the protection of interior finishes becomes more important since a drainable cavity does not exist. Interior finishes that can be damaged by moisture which migrates from the outside must be protected. The interior surface of the masonry must be parged and covered with a No. 15 asphalt-saturated paper which is lapped at least 100 mm (4") at the joints. The paper can be omitted if the insulation applied directly to the masonry limits the passage of water vapour and is applied with a waterproof adhesive or with mortar as shown in Figure 7.41.

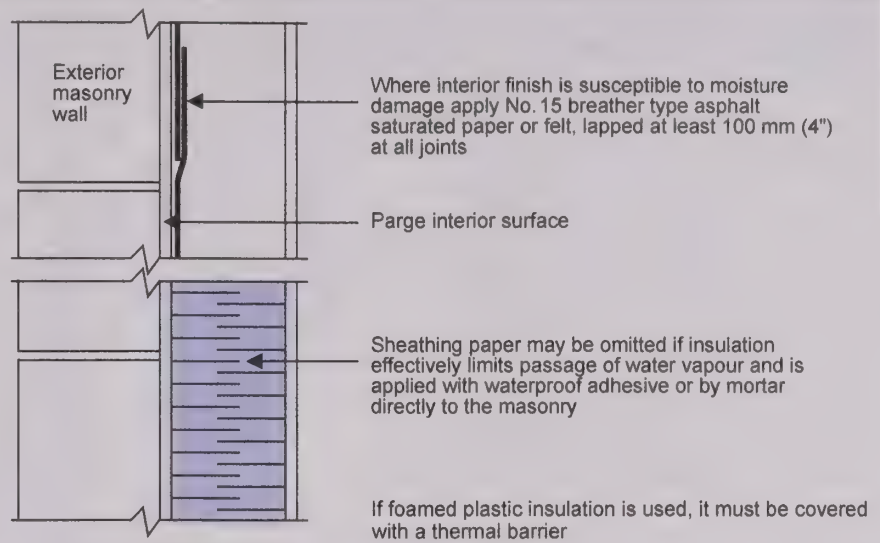


Figure 7.41
Interior Finish of Exterior Masonry Walls (9.20.13.9.)

LOG CONSTRUCTION

BUILDING CODE REFERENCES

DIVISION B

9.37.1.1.	Material Requirements
9.37.1.2.	Requirement for Wood Preservative
9.37.1.3.	Exterior Joints
9.37.2.1.	Logs
9.37.2.2.	Attachment of Logs
9.37.2.3.	Joining Logs
9.37.2.4.	Vertical Logs
9.37.2.5.	Plates
9.37.3.1.	Support Over Openings
9.37.3.2.	Clearance

The Code provisions for log construction are intended to establish a minimum level of performance from the envelope. The provisions are not exhaustive and complement established good building practices.

Log walls can be built of natural or manufactured logs. The logs should be sound and free of fractures and must be structurally adequate for their intended purpose. Logs that come into contact with soil or with masonry or concrete at ground level must be treated with a wood preservative to prevent decay.

Wall Construction

All exterior joints between logs must be made water-tight by chinking, caulking, parging with cement, packing with oakum or by matching the joint. These or similar methods can be used singly or in combination to give the wall a water-tight joint. Interlocking intersections must be provided in walls made of horizontally-placed logs to prevent the collection of water in the joints; alternatively, the horizontal logs must butt to a vertical corner post to which the horizontal logs are firmly attached.

Horizontally-placed logs must be attached in at least three places to the log beneath at a spacing never more than 1.8 m (5' 11"). Lintels over openings must conform to the lintel requirements of the Code (see Subsection 9.23.12.). Where shrinkage of logs may occur special accommodation must be made at wall openings. A 13 mm (1/2") clearance for each 300 mm (11-3/4") in height must be provided between the rough buck header and the lintel log.

FLAT INSULATING CONCRETE FORMS

BUILDING CODE REFERENCES

DIVISION B

- 9.20.17.1. Thickness of Flat Insulating Concrete Form Walls
- 9.20.17.2. Reinforcement for Flat Insulating Concrete Form Walls
- 9.20.17.3. Openings in Non-Loadbearing Flat Insulating Concrete Form Walls
- 9.20.17.4. Openings in Loadbearing Flat Insulating Concrete Form Walls
- 9.20.17.5. Framing Supported on Flat Insulating Concrete Form Walls
- 9.20.17.6. Anchoring of Roof Framing to Top of Flat Insulating Concrete Form Walls
- 9.20.17.7. Protection from Precipitation and Damage

Insulating Concrete Forms (ICFs) are permanent forms made of foam plastic that enclose walls of solid concrete and act as wall insulation at the same time. The Code requires the foam plastic used in ICFs be manufactured of Type 2, 3, or 4 polystyrene conforming to the performance requirements of CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering". ICFs walls above-ground must be protected from precipitation and damage like all other masonry walls as required by Section 9.27. of the Code. Chapter 15 Exterior Finishes provides a summary of these requirements.

Thickness

The thickness of ICF walls should be designed to resist loads and provide sufficient bearing for other supported elements. The thickness of the concrete in ICF walls above-ground must be not less than 140 mm (5-1/2") for the entire height of the wall.

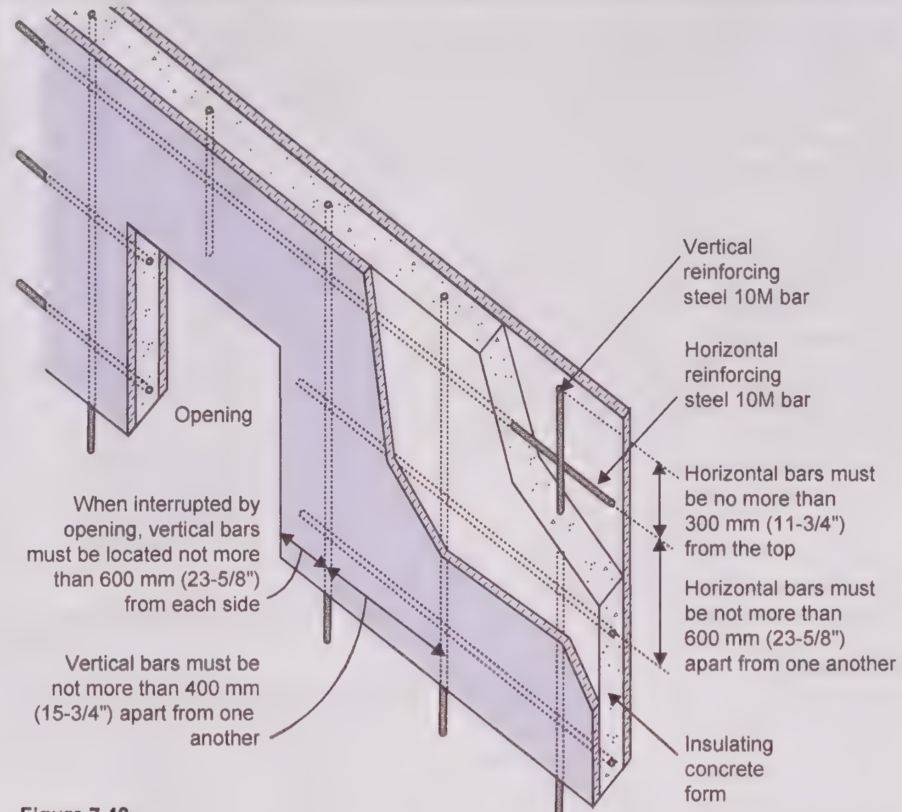


Figure 7.42
Reinforcement
(9.20.17.2.)

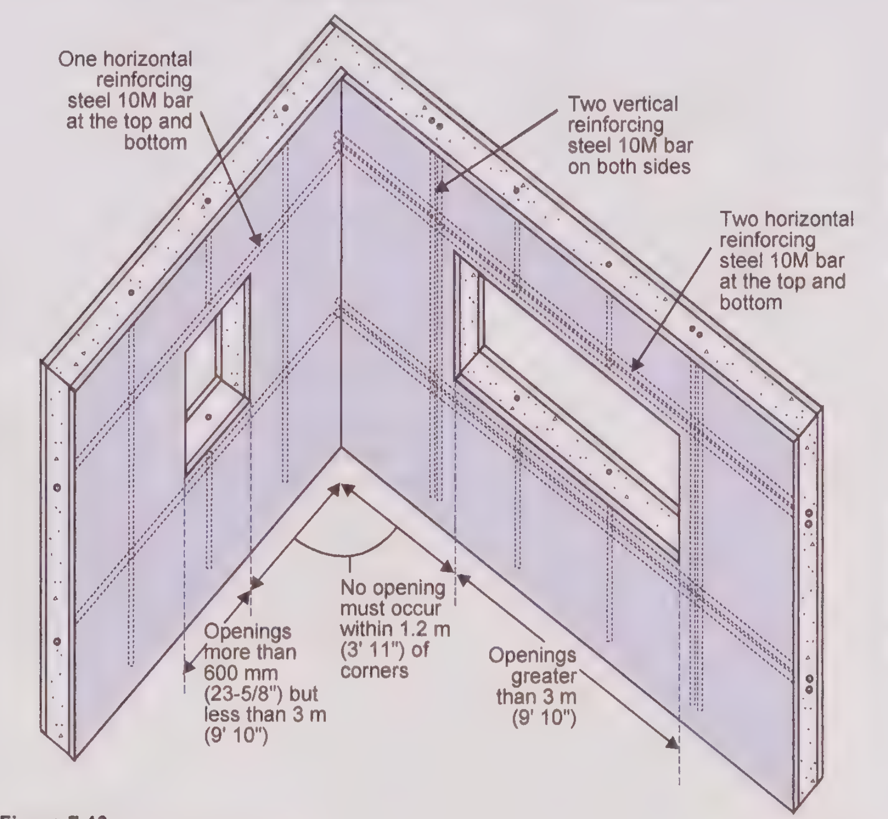


Figure 7.43
Reinforcement Around Openings
(9.20.17.3.)

Reinforcement

Horizontal and vertical reinforcements must be placed in the middle third of the ICF wall section. Horizontal reinforcement consisting of 10M bars must be installed and spaced not more than 600 mm (23-5/8") apart and not more than 300 mm (11-3/4") from the top of the wall. Vertical reinforcement consisting of 10M bars must be installed and spaced not more than 400 mm (15-3/4") apart. Where vertical reinforcement is interrupted by wall openings it must be installed not more than 600 mm (23-5/8") from the sides of the opening. See Figure 7.42.

Openings

No openings must occur within 1.2 m (3' 11") of interior and exterior corners. Areas of ICF walls over openings must have a minimum depth of concrete of 200 mm (7-7/8") over the width of the opening.

Reinforcement of openings must be provided to transfer loads around the opening. Openings more than 600 mm (23-5/8") but not more than 3 m (9' 10") in width must be reinforced at the top and bottom with one 10M bar. In addition, openings more than 3 m (9' 10") in width must be reinforced on all four sides with two 10M bars.

On any ICF wall, the cumulative width of openings must not be more than 70% of the length of the wall in order for the wall to properly resist the anticipated loads. Figure 7.43 summarizes the above requirements.

Openings in flat loadbearing ICF walls must be designed with lintels to provide adequate support and maintain structural integrity. Lintels must be provided over all openings wider than 900 mm (2' 11"). Figure 7.44 summarizes the requirements for lintels where one 10M bottom bar is used. Additional lintel provisions can be found in Tables A-17 to A-19 of the Code.

Maximum Allowable Clear Spans for Lintels in Flat Loadbearing Concrete Form (ICF) Walls(1)(2)(3) (1-10M Bottom Bar)

Minimum Lintel Thickness mm (in)	Minimum Lintel Depth mm (in)	Maximum Clear Span, m (ft-in)			
		Support Light-Frame Roof Only		Supporting ICF Second Storey and Light-Frame Roof	
		Maximum Ground Snow Load, kN/m²			
		1.5	3.33	1.5	3.33
140 (5-1/2")	200 (7-7/8")	1.41 (4' 7")	1.18 (3' 10")	1.03 (3' 5")	0.93 (3' 1")
	300 (11-3/4")	1.78 (5' 10")	1.50 (4' 11")	1.30 (4' 3")	1.18 (3' 10")
	400 (15-3/4")	2.08 (6' 10")	1.75 (5' 9")	1.53 (5' 0")	1.38 (4' 6")
	500 (19-11/16")	2.33 (7' 8")	1.97 (6' 6")	1.72 (5' 8")	1.56 (5' 1")
	600 (23-3/8")	2.55 (8' 4")	2.16 (7' 1")	1.89 (6' 2")	1.71 (5' 7")
150 (6")	200 (7-7/8")	1.41 (4' 7")	1.18 (3' 10")	1.02 (3' 4")	0.92 (3' 0")
	300 (11-3/4")	1.78 (5' 10")	1.50 (4' 11")	1.29 (4' 3")	1.17 (3' 10")
	400 (15-3/4")	2.08 (6' 10")	1.75 (5' 9")	1.51 (4' 11")	1.37 (4' 6")
	500 (19-11/16")	2.33 (7' 8")	1.97 (6' 6")	1.70 (5' 7")	1.54 (5' 1")
	600 (23-3/8")	2.54 (8' 4")	2.15 (7' 1")	1.87 (6' 2")	1.70 (5' 7")
160 (6-3/8")	200 (7-7/8")	1.41 (4' 7")	1.18 (3' 10")	1.01 (3' 4")	0.91 (2' 12")
	300 (11-3/4")	1.78 (5' 10")	1.50 (4' 11")	1.28 (4' 2")	1.16 (3' 10")
	400 (15-3/4")	2.07 (6' 9")	1.75 (5' 9")	1.50 (4' 11")	1.36 (4' 6")
	500 (19-11/16")	2.31 (7' 7")	1.96 (6' 5")	1.68 (5' 6")	1.53 (5' 0")
	600 (23-3/8")	2.53 (8' 4")	2.15 (7' 1")	1.85 (6' 1")	1.68 (5' 6")
190 (7-1/2")	200 (7-7/8")	1.41 (4' 7")	1.19 (3' 11")	0.98 (3' 3")	0.89 (2' 11")
	300 (11-3/4")	1.78 (5' 10")	1.50 (4' 11")	1.24 (4' 1")	1.13 (3' 8")
	400 (15-3/4")	2.06 (6' 9")	1.74 (5' 8")	1.45 (4' 9")	1.32 (4' 4")
	500 (19-11/16")	2.30 (7' 7")	1.95 (6' 5")	1.63 (5' 4")	1.49 (4' 11")
	600 (23-3/8")	2.51 (8' 3")	2.13 (6' 12")	1.78 (5' 10")	1.63 (5' 4")
200 (7-7/8")	200 (7-7/8")	1.41 (4' 7")	1.19 (3' 11")	0.97 (3' 2")	0.89 (2' 11")
	300 (11-3/4")	1.77 (5' 10")	1.49 (4' 11")	1.23 (4' 0")	1.12 (3' 8")
	400 (15-3/4")	2.06 (6' 9")	1.74 (5' 8")	1.43 (4' 8")	1.31 (4' 4")
	500 (19-11/16")	2.30 (7' 7")	1.95 (6' 5")	1.61 (5' 3")	1.48 (4' 10")
	600 (23-3/8")	2.50 (8' 2")	2.13 (6' 12")	1.77 (5' 10")	1.62 (5' 4")
240 (9-1/2")	200 (7-7/8")	1.41 (4' 7")	1.19 (3' 11")	0.94 (3' 1")	0.86 (2' 10")
	300 (11-3/4")	1.76 (5' 9")	1.49 (4' 11")	1.18 (3' 10")	1.09 (3' 7")
	400 (15-3/4")	2.04 (6' 8")	1.73 (5' 8")	1.38 (4' 6")	1.27 (4' 2")
	500 (19-11/16")	2.27 (7' 5")	1.93 (6' 4")	1.55 (5' 1")	1.43 (4' 8")
	600 (23-3/8")	2.47 (8' 1")	2.11 (6' 11")	1.70 (5' 7")	1.56 (5' 1")

Notes
(1) Deflection criteria is L/240, where "L" is the clear span of the lintel.
(2) Linear interpolation is permitted between ground snow loads and between lintel depths.
(3) 10M stirrups are required at a maximum d/2 spacing for spans greater than 1 200 mm (3' 11"), where "d" is the distance from the top of the lintel to the level of the bottom reinfocing bar in the lintel.

Figure 7.44
Lintels in Flat Loadbearing Concrete Form (9.20.17.4.(1))

Maximum Anchor Bolt Spacing for the Connection of Ledger Boards to Flat Insulating Concrete Form Walls

Maximum Clear Floor Span, m (ft-in)	**Maximum Anchor Bolt Spacing**, mm (in)	
	Staggered 12.7 mm (1/2") Diameter Anchor Bolts	Staggered 16 (5/8") Diameter Anchor Bolts
2.44 (8' 0")	450 (17-3/4")	500 (19-11/16")
3.00 (9' 10")	400 (15-3/4")	350 (17-3/4")
4.00 (13' 1-1/2")	300 (11-3/4")	400 (15-3/4")
5.00 (16' 4-3/4")	275 (10-7/8")	325 (12-3/4")

Figure 7.45
Anchor Bolt Spacing
(9.20.17.5.)

Supported Framing

Floor joists supported on the side of flat ICF walls should be supported with joist hangers secured to wood ledger boards. The ledger boards should be not less than 38 mm (2" nominal) thick with a depth at least that of the floor joists and anchored to the concrete wall. Anchor bolts must be embedded at least 100 mm (4") into the concrete. Figure 7.45 provides the maximum spacing requirements for ledger board anchorage. See Figure 7.46.

Roof Anchorage

Roof framing supported on the top of flat ICF walls should be fixed to top plates. The top plates should be anchored to the wall with anchor bolts placed in the centre of the wall. These bolts must be not less than 12.7 mm (1/2") in diameter and must be embedded not less than 100 mm (4") and spaced not more than 1.2 m (3'11") o.c.

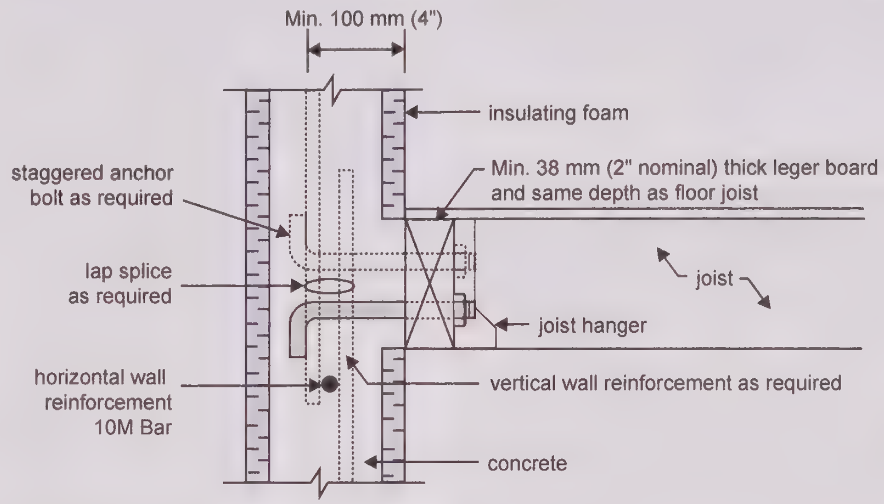
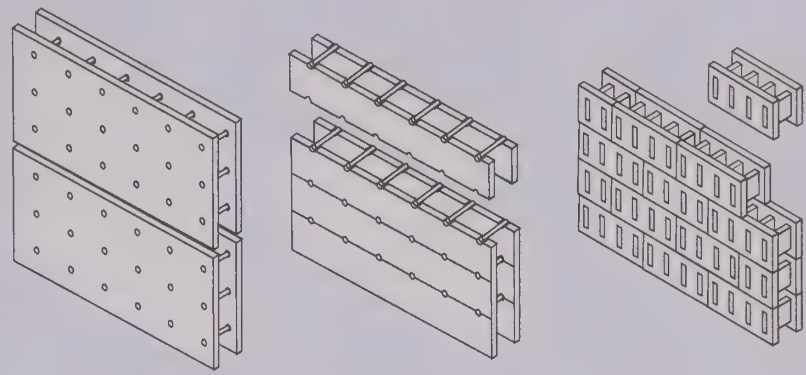


Figure 7.46
Floor Ledger-ICF Wall Connection
(9.20.17.5.)
(9.20.17.6.)

Insulating Concrete Forms

ICF systems all work on the same principle (filling foam forms with concrete), but they have three differences that are important for the contractor:

1) the size of the form units and the ways the forms connect to one another (panel, plank, or block),
2) the shape of the cavities into which the concrete is placed, and
3) whether the formwork has surfaces to which wall finishes, utilities components, and other items can be fastened with screws or nails.



Panel Plank Block

Because the design of ICF units and the methods of connecting them differ from system to system, the details of the setting procedure also vary. ICF manufacturers provide instructions for setting their forms, and these must be followed. Where adopted by a Minister's Ruling, a Canadian Construction Materials Centre (CCMC) Evaluation Report also provides instructions for specific ICF systems.

Concrete Characteristics

It is usually desirable to fill ICFs with concrete that flows better than the concrete used in conventional construction. Good flow is important to moving well through a pump (which may be used) and filling the formwork cavities thoroughly. Workability is improved by varying the proportions of the ingredients or by using appropriate admixtures.

Most ICF manufacturers have recommended concrete specifications to use with their forms. CCMC Evaluation Reports specify the compressive strength (and may specify maximum aggregate size, or type of concrete) for use in specific proprietary ICFs.

Dampproofing ICFs

ICFs cannot be left exposed to the soil, and basement walls made of ICFs should be coated with dampproofing or waterproofing material just as block and conventional solid walls are.

Before applying dampproofing it is not necessary to have the foam surface perfectly smooth or straight; it is generally enough to first rasp or sand any extremely sharp jags in the surface. Any foam that has deteriorated in the sun should be scraped off. Deteriorated foam forms a yellowish powder that can pull away and reduce the adhesion of the finish.

Any coating used should be labelled "solvent-free" or "nonsolvent based," since materials containing solvents will dissolve the foam.

Weather Considerations

Few weather considerations affect concrete placement because the foam formwork insulates the concrete, allowing it to cure almost regardless of outside temperature or humidity. If the temperature is below freezing, or will go below freezing in the next couple of days after the pour, the top of the wall should be insulated after pouring. To do this, the builder can lay fiberglass batts or some other type of insulating blanket over the concrete everywhere it is exposed. Fiberglass and many other insulation lose their insulating ability if they are wet, so if rain or snow is likely the insulation needs to be covered with plastic sheet or a moisture-resistant insulation should be used instead.

(Adapted from Insulating Concrete Forms Construction Manual, Vanderwerf & Munsell)

8 ROOFING SYSTEMS

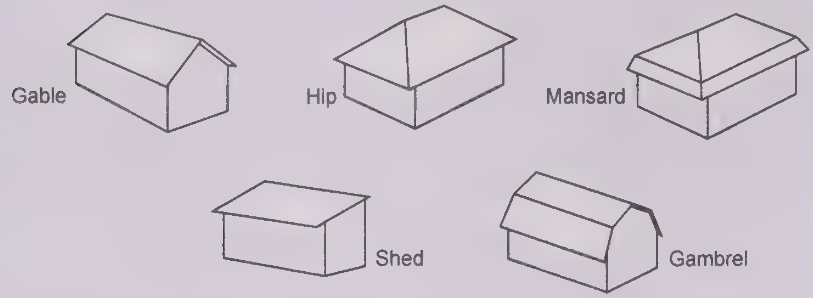
The primary purpose of a roof is to protect the building from the elements. The roof supports snow loads, sheds rain and can help control the movement of heat into and from the building. Roof framing provides a base that supports roof finishes and resists wind and snow loads that act on the building. Strength and rigidity are important characteristics of any roof system and are among the provisions of the Code that will be specifically detailed in this chapter.

Exterior roofing finishes will also be discussed since they immediately follow the framing and the sheathing of the roof.

KEY POINTS

The dwelling unit's roof must be designed and constructed to fulfill the following functions:

- transfer wind, snow and dead loads to the dwelling unit walls;
- shed rain and snow away from the building and prevent water from penetrating into the roof space;
- provide for the removal of moisture and heat in insulated roof assemblies; and
- accommodate the installation of materials designed to restrict the flow of air, moisture and heat from the dwelling unit into the roof assembly.



Common Roof Types

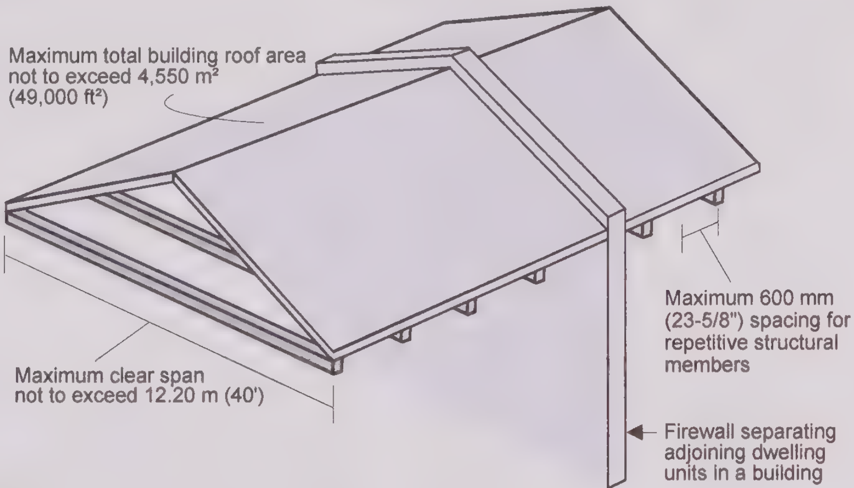
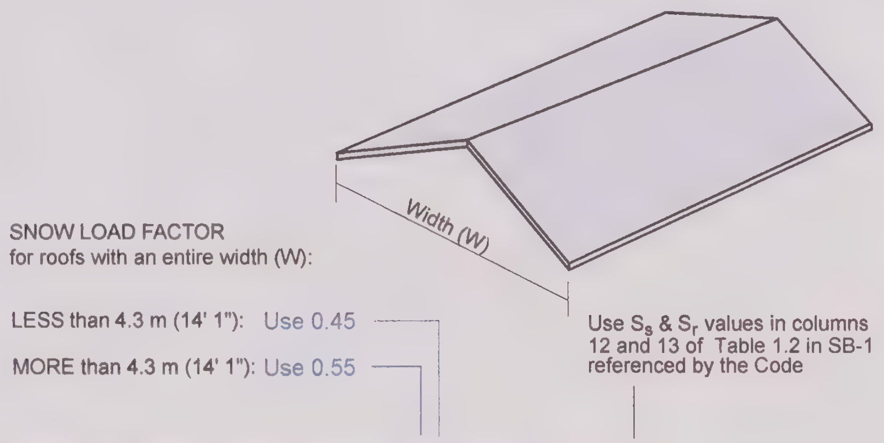


Figure 8.1
Maximum Roof Area
(9.4.2.1.)



Specified Snow Load = (Snow Load Factor x S_s) + S_r

Note: snow loads can never be less than 1 kPa (20.9 psf)

Figure 8.2
Specified Snow Load
(9.4.2.2.)

WOOD FRAMING

BUILDING CODE REFERENCES

DIVISION B

9.4.2.1.	Application
9.4.2.2.	Specified Design Snow Loads
9.20.8.2.	Cavity Walls Supporting Framing Members
9.20.11.4.	Wood Frame Roof Systems
9.23.4.5.	Heavy Roofing Materials
9.23.5.5.	Roof Trusses
9.23.13.1.	Continuity of Rafters and Joists
9.23.13.2.	Framing around Openings
9.23.13.3.	End Bearing Length
9.23.13.4.	Location and Attachment of Rafters
9.23.13.5.	Shaping of Rafters
9.23.13.6.	Hip and Valley Rafters
9.23.13.7.	Intermediate Support for Rafters and Joists
9.23.13.8.	Ridge Support
9.23.13.9.	Restraint of Joist Bottoms
9.23.13.10.	Ceiling Joists Supporting Roof Load
9.23.13.11.	Wood Roof Trusses

This chapter details the requirements for conventional light frame roofs composed of small repetitive structural members spaced not more than 600 mm (23-5/8") o.c. Roofing systems not explicitly provided for in this section include: open web steel joist systems, metal decks, precast and solid concrete, wood I's, and structural insulated panels, all of which must be designed according to the provisions of Part 4 of the Code. Part 4 design methods must also be used for wood trusses. A wide variety of roof types can be designed using the Code including the five common roofs illustrated.

Structural Requirements

Part 9 of the Code is restricted to the design of light frame roof assemblies composed of small repetitive structural members with clear spans that do not exceed 12.2 m (40'), with framing that is spaced not more than 600 mm (23-5/8") apart and clad, sheathed or braced on at least one side. Part 4 of the Code must be used for all other cases. The maximum allowable roof area for Part 9 buildings must not be more than 4,550 m² (48,976 ft²) where building roofs are adjoined by separating firewalls. Figure 8.1 illustrates these requirements.

The snow loads for specific locations throughout Ontario can be determined by referring to Figure 8.2

Roof Nailing

The nailing requirements for roof framing members are summarized in Figure 8.3.

Roof Assemblies and Masonry Walls

To resist wind forces, roofs must be anchored firmly to masonry walls. Wood frame roof systems must be anchored to masonry walls with anchor bolts that are at least 12.7 mm (1/2") in diameter spaced not more than 2.4 m (7' 10") apart. The bolt must be embedded at least 90 mm (3-1/2") into the masonry and fastened to a rafter plate that is at least 38 mm (1-1/2") thick. See Figure 8.4.

Roof assemblies can be used to support masonry walls which require lateral bracing. The requirements for the spacing and support of masonry walls are found in Chapter 7, Wall Systems.

Roof and ceiling framing which bear on masonry cavity walls must be supported by 57 mm (2-1/4") of solid masonry bridging the full thickness of the wall. Alternatively, a wood plate at least 38 mm (1-1/2") thick that bears 50 mm (2") or more on each wythe can be used. Hollow masonry walls which support roof loads must be capped with solid masonry or concrete. Refer to Chapter 7, Wall Systems for more details.

Looking Back

See Chapter 7 Wall Systems

Roof Nailing

Connection	Nail Length mm (in)	Number
Ceiling joist to plate - toe nail each end	82 (3-1/4")	2
Roof rafter, roof truss or roof joist to plate - toe nail	82 (3-1/4")	3
Rafter plate to each ceiling joist	101 (4")	2
Rafter to joist (with ridge supported)	76 (3")	3
Rafter to joist (with ridge unsupported)	76 (3")	See Table 9.23.13.8. of Code
Gusset plate to each rafter at peak	57 (2-1/4")	4
Rafter to ridge board - toe nail - end nail	82 (3-1/4")	3
Collar tie to rafter - each end	76 (3")	3
Collar tie lateral support to each collar tie	57 (2-1/4")	2
Jack rafter to hip or valley rafter	82 (3-1/4")	2
Roof strut to rafter	76 (3")	3
Roof strut to loadbearing wall - toe nail	82 (3-1/4")	2

Figure 8.3
Roof Nailing (9.23.3.4.)

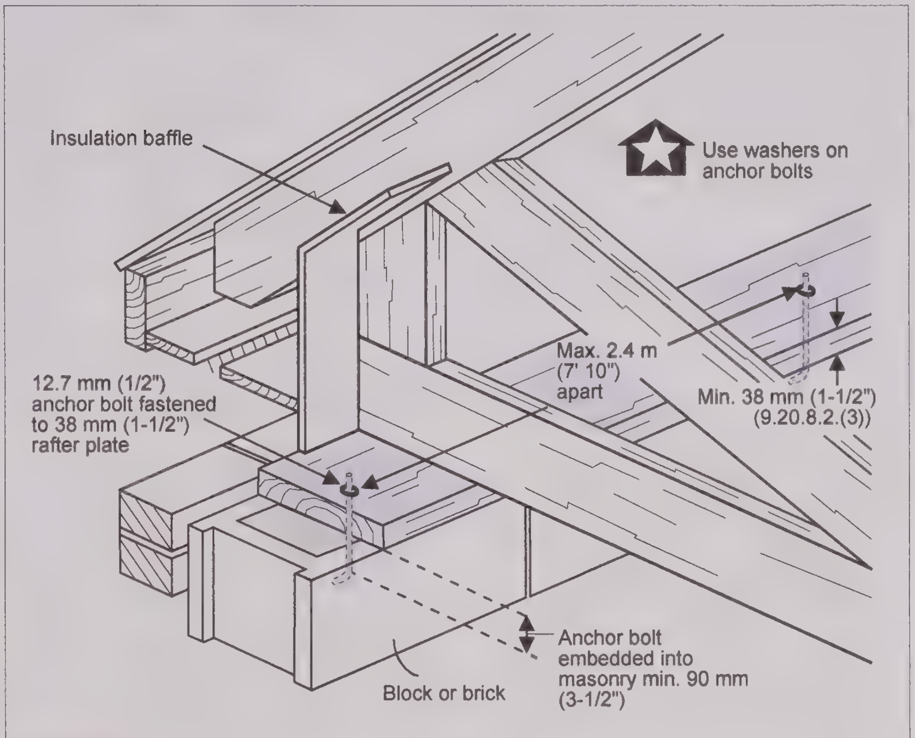


Figure 8.4
Anchoring Roof Frames to Masonry Walls (9.20.11.4.)

Spans for Joists and Rafters

Span tables are provided for the selection of rafters, ceilings and roof joists in the Appendix to Part 9 of the Code. The span is measured from the inside face or edge of support to the inside face or edge of support. In the case of sloping members, the span is measured as the horizontal distance between supports and not the dimension. Ensure the appropriate table is used for the specific member. (Refer to Figure 8.5). Variables that must be identified prior to the use of the span tables include species and grade of the wood to be used, specified snow load of the particular location, type of ceiling finish, and attic usage. Figures 8.6 to 8.9 provide the maximum spans for common roof members in dwelling units.

Spans and spacing of joists and rafters derived from the span tables must be reduced where heavy roofing materials such as clay tile or concrete are used. Proper design must account for the additional load these materials add to the roofing system.

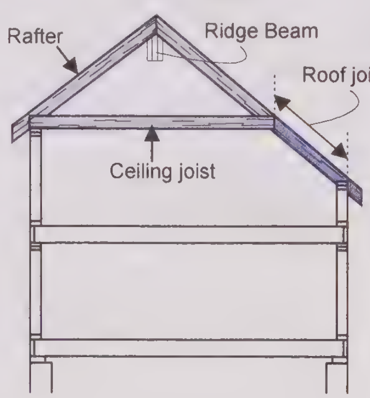


Figure 8.5
Roof Members

Identify required span from plans/drawings

Find appropriate Table in Housing Code applying to the type of member

Establish the grade of lumber - assume No. 2 Grade SPF

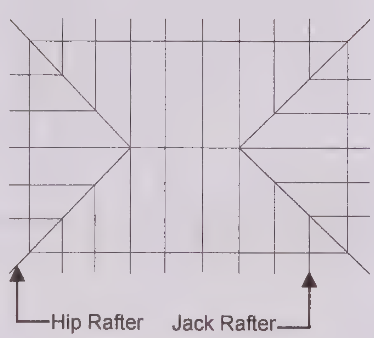
Determine required size and spacing of member

You may be able to alter the member size by:

- specifying better grade of lumber,
- altering span through use of collar ties, struts, or knee walls,
  or
- reducing spacing between members

Using the Span Tables

Hip Roof Plan



Maximum Spans for Ceiling Joists in Attics not Accessible by Stairways
Spruce-Pine-Fir : No. 1 & 2 Grade

Member Size	Joist Spacing		
	305 mm (12")	406 mm (16")	610 mm (24")
mm (in)	m (ft-in)	m (ft-in)	m (ft-in)
38 x 89 (2 x 4)	3.11 (10' 2")	2.83 (9' 3")	2.47 (8' 1")
38 x 140 (2 x 6)	4.90 (16' 0")	4.45 (14' 7")	3.89 (12' 9")
38 x 184 (2 x 8)	6.44 (21' 1")	5.85 (19' 2")	5.11 (16' 9")
38 x 235 (2 x 10)	8.22 (26' 11")	7.47 (24' 6")	6.52 (21' 4")
38 x 286 (2 x 12)	10 (32' 9")	9.09 (29' 9")	7.94 (26' 0")

Note:
All imperial values are based on hard conversion of metric span values which are based on 305 mm, 406 mm, and 610 mm (12", 16", and 24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Spruce-Pine-Fir includes Spruce (all species expect Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir.

Figure 8.6
Ceiling Joist Spans (9.23.4.2.)

Maximum Spans for Roof Rafters - Spruce-Pine-Fir, No. 1 & 2 Grade (m (ft-in))

Member Size	Rafter Spacing			Rafter Spacing		
mm (in)	305 mm (12")	406 mm (16")	610 mm (24")	305 mm (12")	406 mm (16")	610 mm (24")
Specified Snow Load:	**1.0 kPa (20.9 psf)**			**1.5 kPa (31.3 psf)**		
38 x 89 (2 x 4)	3.11 (10' 2")	2.83 (9' 3")	2.47 (8' 1")	2.72 (8' 11")	2.47 (8' 1")	2.16 (7' 1")
38 x 140 (2 x 6)	4.90 (16' 0")	4.45 (14' 7")	3.89 (12' 9")	4.28 (14' 0")	3.89 (12' 9")	3.40 (11' 1")
38 x 184 (2 x 8)	6.44 (21' 1")	5.85 (19' 2")	5.11 (16' 9")	5.62 (18' 5")	5.11 (16' 9")	4.41 (14' 5")
38 x 235 (2 x 10)	8.22 (26' 11")	7.47 (24' 6")	6.38 (20' 11")	7.18 (23' 6")	6.52 (21' 4")	5.39 (17' 8")
38 x 286 (2 x 12)	10.00 (32' 9")	9.06 (29' 8")	7.40 (24' 3")	8.74 (28' 8")	7.66 (25' 1")	6.25 (20' 6")
Specified Snow Load:	**2.0 kPa (41.8 psf)**			**2.5 kPa (52.2 psf)**		
38 x 89 (2 x 4)	2.47 (8' 1")	2.24 (7' 4")	1.96 (6' 5")	2.29 (7' 6")	2.08 (6' 9")	1.82 (5' 11")
38 x 140 (2 x 6)	3.89 (12' 9")	3.53 (11' 6")	3.08 (10' 1")	3.61 (11' 10")	3.28 (10' 9")	2.86 (9' 4")
38 x 184 (2 x 8)	5.11 (16' 9")	4.64 (15' 2")	3.89 (12' 9")	4.74 (15' 6")	4.31 (14' 1")	3.52 (11' 6")
38 x 235 (2 x 10)	6.52 (21' 4")	5.82 (19' 1")	4.75 (15' 7")	6.06 (19' 10")	5.27 (17' 3")	4.30 (14' 1")
38 x 286 (2 x 12)	7.80 (25' 7")	6.76 (22' 2")	5.52 (18' 1")	7.06 (3' 1")	6.11 (20' 0")	4.99 (16' 4")
Specified Snow Load:	**3.0 kPa (62.7 psf)**					
38 x 89 (2 x 4)	2.16 (7' 1")	1.96 (6' 5")	1.71 (5' 7")			
38 x 140 (2 x 6)	3.40 (11' 1")	3.08 (10' 1")	2.66 (8' 8")			
38 x 184 (2 x 8)	4.46 (14' 7")	3.96 (12' 11")	3.23 (10' 7")			
38 x 235 (2 x 10)	5.59 (18' 4")	4.84 (15' 10")	3.96 (12' 11")			
38 x 286 (2 x 12)	6.49 (21' 3")	5.62 (18' 5")	4.59 (15' 0")			

Note:
All imperial values are based on hard conversion of metric span values which are based on 305 mm, 406 mm, and 610 mm (12", 16", and 24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Spruce-Pine-Fir includes Spruce (all species expect Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir.

Figure 8.7
Roof Rafter Spans (9.23.4.2.)

Roof and Ceiling Framing

Rafters, roof and ceiling joists must be continuous across their spans. If splices are required, they must be supported.

Rafters are typically located opposite each other and tied together at the roof peak. Rafters can be offset one rafter width if they are nailed to a ridge board which is at least 17.5 mm (11/16") thick. The end bearing of rafters and joists must be at least 38 mm (1-1/2"). At the support, the rafter must be shaped to bear evenly over the support as illustrated in Figure 8.10.

Hip and valley rafters must be at least 50 mm (2") deeper than common rafters and must not be less than 38 mm (1-1/2") thick.

Dwarf walls and struts can be used to reduce the span of roof joists and rafters, see Figure 8.11. Where the roof slope is 1 in 3 or greater, ceiling joists and collar ties can also be used. Collar ties and ceiling joists must be at least 38 mm by 89 mm (2 x 4) to be effective. In addition, if the collar ties are longer than 2.4 m (7' 10") they must be laterally supported near their centres by 19 mm x 89 mm (1 x 4) strapping applied at right angles to the collar ties.

Struts that are installed to reduce the span of rafters must be connected to loadbearing walls at an angle not less than 45° to the horizontal and must be not less than 38 mm by 89 mm (2 x 4). Ceiling joists that support roof loads from struts or dwarf walls must be at least 25 mm (1") deeper than normal ceiling joists. The roof joist span tables must be used to select these ceiling joists when the roof slope is 1 in 4 or less. Figure 8.11 illustrates these requirements.

Maximum Spans for Roof Joists - Spruce-Pine-Fir, No. 1 & 2 Grade (m (ft-in))

Member Size	Rafter Spacing			Rafter Spacing		
mm (inches)	305 mm (12")	406 mm (16")	610 mm (24")	305 mm (12")	406 mm (16")	610 mm (24")
Specified Snow Load:	**1.0 kPa (20.9 psf)**			**1.5 kPa (31.3 psf)**		
38 x 89 (2 x 4)	2.47 (8' 1")	2.24 (7' 4")	1.96 (6' 5")	2.16 (7' 1")	1.96 (6' 5")	1.71 (5' 7")
38 x 140 (2 x 6)	3.89 (12' 9")	3.53 (11' 6")	3.08 (10' 1")	3.40 (11' 1")	3.08 (10' 1")	2.69 (8' 9")
38 x 184 (2 x 8)	5.11 (16' 9")	4.64 (15' 2")	4.05 (13' 3")	4.46 (14' 7")	4.05 (13' 3")	3.54 (11' 7")
38 x 235 (2 x 10)	6.52 (21' 4")	5.93 (19' 5")	5.18 (16' 11")	5.70 (18' 8")	5.18 (16' 11")	4.52 (14' 9")
38 x 286 (2 x 12)	7.94 (26' 0")	7.21 (23' 7")	6.30 (20' 8")	6.94 (22' 9")	6.30 (20' 8")	5.50 (18' 0")
Specified Snow Load:	**2.0 kPa (41.8 psf)**			**2.5 kPa (52.2 psf)**		
38 x 89 (2 x 4)	1.96 (6' 5")	1.78 (5' 10")	1.56 (5' 1")	1.82 (5' 11")	1.65 (5' 4")	1.44 (4' 8")
38 x 140 (2 x 6)	3.08 (10' 1")	2.80 (9' 2")	2.45 (8' 0")	2.86 (9' 4")	2.60 (8' 6")	2.27 (7' 5")
38 x 184 (2 x 8)	4.05 (13' 3")	3.68 (12' 0")	3.22 (10' 6")	3.76 (12' 4")	3.42 (11' 2")	2.99 (9' 9")
38 x 235 (2 x 10)	5.18 (16' 11")	4.70 (15' 5")	4.11 (13' 5")	4.81 (15' 9")	4.37 (14' 4")	3.82 (12' 6")
38 x 286 (2 x 12)	6.30 (20' 8")	5.73 (18' 9")	5.00 (16' 4")	5.85 (19' 2")	5.31 (17' 5")	4.64 (15' 2")
Specified Snow Load:	**3.0 kPa (62.7 psf)**					
38 x 89 (2 x 4)	1.71 (5' 7")	1.56 (5' 1")	1.36 (4' 5")			
38 x 140 (2 x 6)	2.69 (8' 9")	2.45 (8' 0")	2.14 (7' 0")			
38 x 184 (2 x 8)	3.54 (11' 7")	3.22 (10' 6")	2.81 (9' 2")			
38 x 235 (2 x 10)	4.52 (14' 9")	4.11 (13' 5")	3.59 (11' 9")			
38 x 286 (2 x 12)	5.50 (18' 0")	5.00 (16' 4")	4.37 (14' 4")			

Note:
All imperial values are based on hard conversion of metric span values which are based on 305 mm, 406 mm, and 610 mm (12", 16", and 24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions.

Spruce-Pine-Fir includes Spruce (all species expect Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir.

Figure 8.8
Roof Joist Spans (9.23.4.2.)

Maximum Spans for Built-up Roof Ridge Beams Supporting the Roof and Ceiling - Spruce-Pine-Fir, No. 1 & 2 Grade (m (ft-in))

Specified Snow Load kPa (psf)	Beam Size mm (in)								
	3-38 x 184 3-(2 x 8)	4-38 x 184 4-(2 x 8)	5-38 x 184 5-(2 x 8)	3-38 x 235 3-(2 x 10)	4-38 x 235 4-(2 x 10)	5-38 x 235 5-(2 x 10)	3-38 x 286 3-(2 x 12)	4-38 x 286 4-(2 x 12)	5-38 x 286 5-(2 x 12)
1.0 (20.9)	2.88 (9' 5")	3.30 (10' 10")	3.55 (11' 8")	3.53 (11' 7")	4.07 (13' 4")	4.54 (14' 11")	4.09 (13' 5")	4.72 (15' 6")	5.28 (17' 4")
1.5 (31.3)	2.48 (8' 2")	2.86 (9' 4")	3.10 (10' 2")	3.03 (9' 11")	3.50 (11' 5")	3.91 (12' 10")	3.52 (11' 7")	4.06 (13' 4")	4.54 (14' 8")
2.0 (41.8)	2.21 (7' 3")	2.55 (8' 4")	2.82 (9' 3")	2.70 (8' 10")	3.12 (10' 2")	3.49 (11' 5")	3.13 (10' 3")	3.62 (11' 11")	4.04 (13' 3")
2.5 (52.2)	2.01 (6' 7")	2.32 (7' 7")	2.59 (8' 6")	2.46 (8' 0")	2.84 (9' 3")	3.17 (10' 4")	2.85 (9' 4")	3.29 (10' 9")	3.68 (12' 0")
3.0 (62.7)	1.86 (6' 1")	2.14 (7' 0")	2.40 (7' 10)	2.27 (7' 5")	2.62 (8' 7")	2.93 (9' 7")	2.63 (8' 3")	3.04 (9' 11")	3.40 (11' 1")

Note:
All imperial values are based on hard conversion of metric span values which are based on 305 mm, 406 mm, and 610 mm (12", 16", and 24") spacings. In some instances, using the Canadian Wood Council Span Book will result in different values. Please check with your municipality before constructing to imperial dimensions. Spruce-Pine-Fir includes Spruce (all species expect Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir.

Figure 8.9
Roof Ridge Beam Spans (9.23.4.2.)

Ridge support must be provided for all roofs with a slope less than 1 in 3. This ridge support can be either a loadbearing wall or ridge beam. The ridge beam must be not less than 38 mm by 140 mm (2 x 6) and must be supported every 1.2 m (3' 11") by 38 mm x 89 mm (2 x 4) vertical members, or designed to Figure 8.9.

Ridge support can be omitted in roofs with a slope of 1 in 3 or more provided the lower ends of the rafters are secured to prevent outward movement. Tie rods or ceiling joists that extend to opposite rafters must be used. Rafter to joist nailing must conform to Figure 8.3 if ridge support is to be omitted.

Roof joists that support gypsum board ceilings must be restrained from twisting by furring, blocking, cross bridging or strapping. This joist restraint is the same as that of floor joists. Refer to Chapter 3, Floor Framing for more details.

Roof and ceiling framing around openings, that are larger than two rafters or joist spacing wide, must be doubled on each side of the opening.

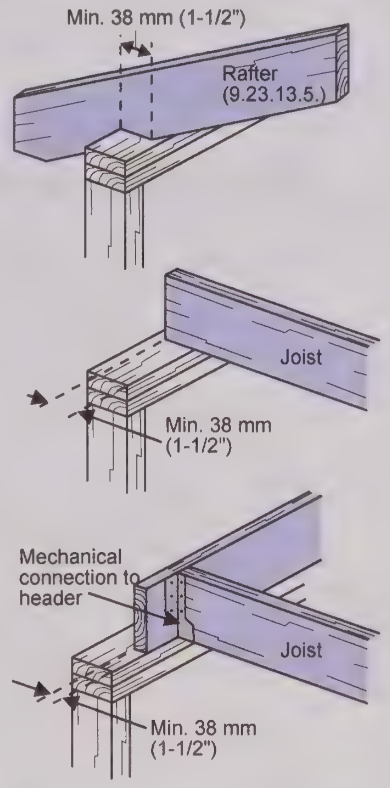


Figure 8.10
Rafter and Joist Bearing (9.23.13.3.)

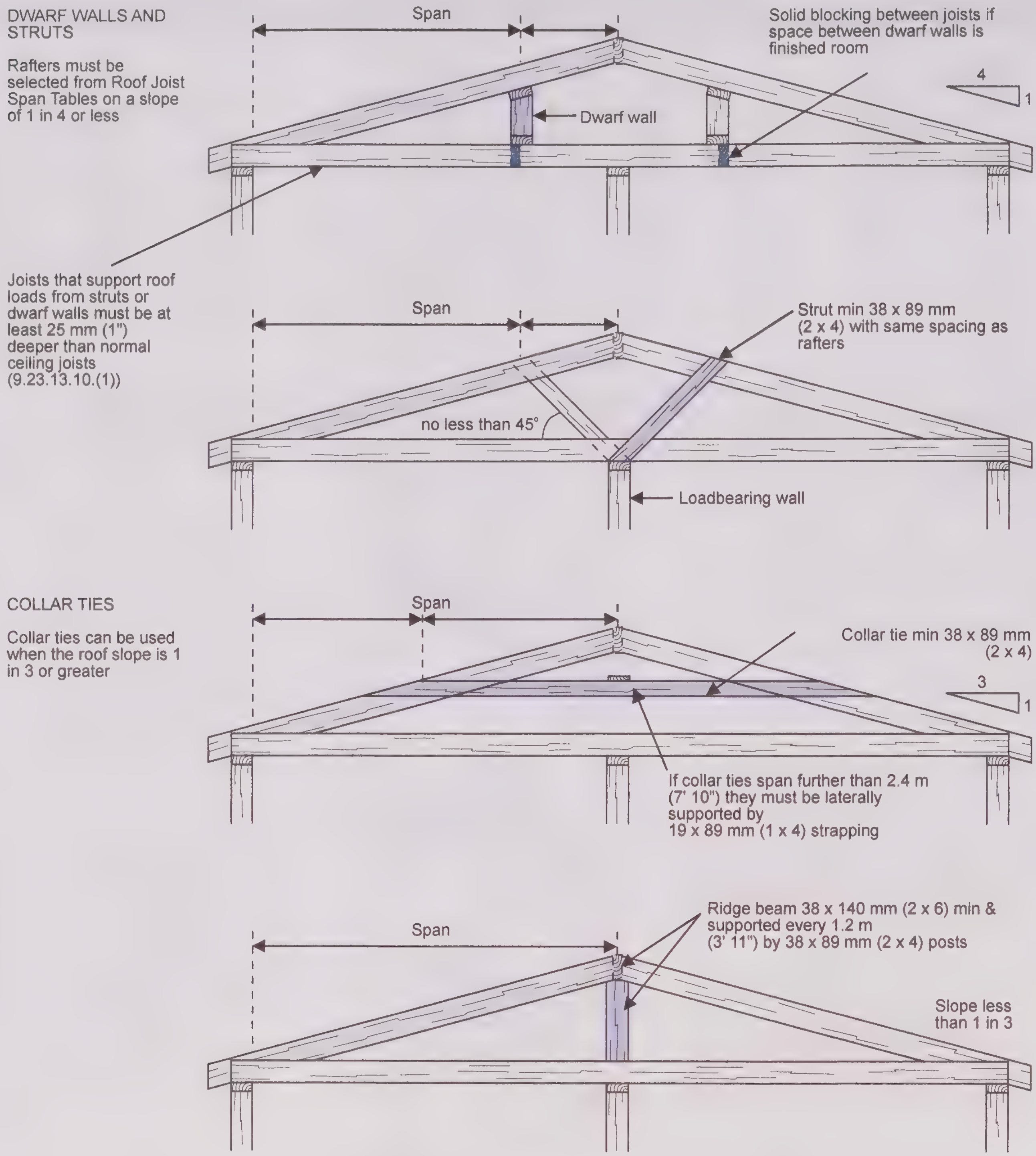


Figure 8.11
Support for Rafters and Joists

(9.23.13.7.)
(9.23.13.8.)

Better Building Note
Ice Damming

Ice damming can be seen throughout the province during winter. In most cases ice dams cause no problem. However, in some severe cases, leakage of melted ice and snow into the building can occur.

Ice dams develop from melting snow on snow-covered roofs. Heat loss from thermal bridging at poorly insulated wall top plates can melt snow during mild, near freezing weather.

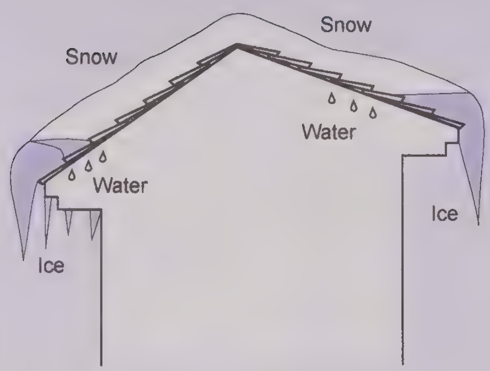
The water from the snow moves down the roof to the colder area of the roof above the soffits. As it runs over this colder roof area, it can refreeze. The newly frozen water can act as a dam to the snow which continues to melt at the exterior wall/ ceiling intersection.

Large ice dams can back water up under shingles beyond the eave protection which is normally installed in Ontario houses. Staining of interior finishes, deterioration of wood roof sheathing and ice accumulation in attics can result from this problem.

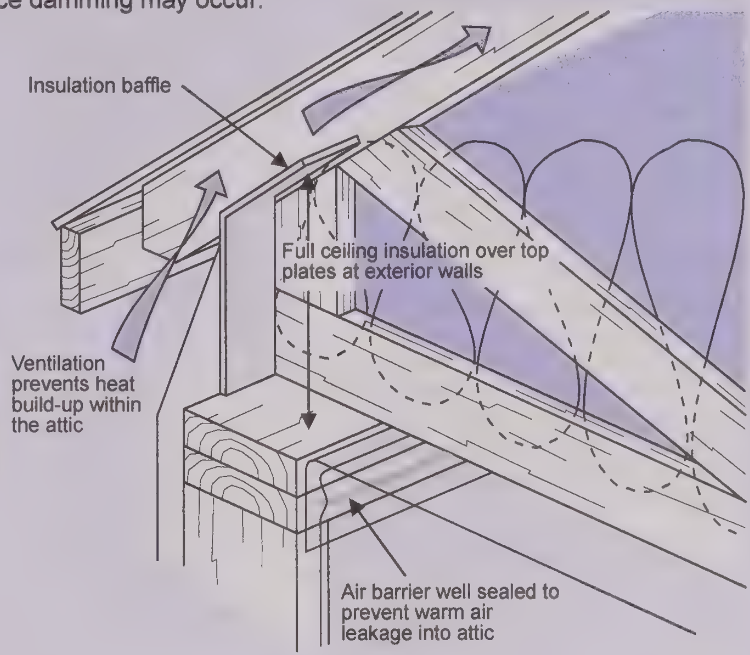
In most cases, eave protection provided up 900 mm (2' 11") from the roof edge or within 300 mm (11-3/4") of the inside wall reduces the negative consequences of ice.

Eave protection will not work for some 'dormers of valleys'. Consider the configuration of the roof and extend eave protection to areas where ice damming may occur.

Full ceiling insulation over top plates at exterior walls helps prevent this problem. This generally requires attention to framing and truss details. Adequate space must be provided in this area to accommodate the additional insulation. Heat loss into the attic which can contribute to the problem should be reduced by carefully sealing the air barrier which separate the attic space from the building. Roof and attic ventilation will prevent heat build-up within the attic and will also help to avoid the problems ice damming can bring.



Formation of Ice Dams



Minimizing Ice Dams

Wood Roof Trusses

Roof trusses have become a popular method for framing roofs. Trusses are most commonly pre-manufactured and pre-engineered to a wide variety of configurations. The use of raised heel, scissor and parallel chord trusses have widened the application of this roofing system.

Generally, all roof trusses must be designed in accordance to Part 4 of the Building Code. In some limited circumstances, trusses can be designed to specific requirements in Part 9 (see Article 9.23.13.11.).

Connections for all trusses must be designed according to the provisions of Part 4. Where compression web members exceed 1.83 m (6') in length, they must be provided with continuous bracing (of at least 19 mm x 89 mm (1 x 4) nailed at right angles to the web members near their centres with at least two 63 mm (2-1/2") nails) to prevent buckling.

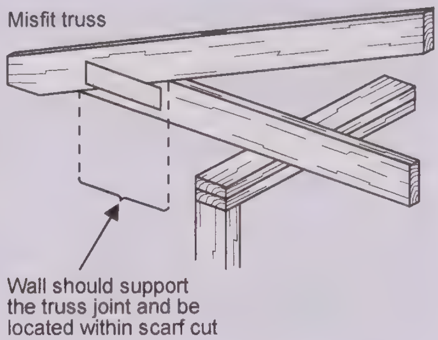
Notching and Drilling

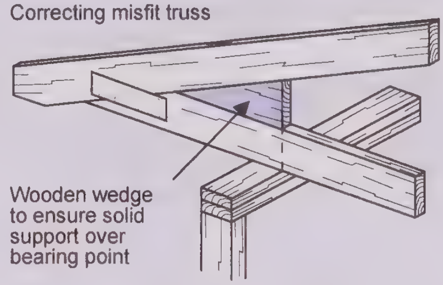
The notching and drilling provisions for roof framing are similar to those for floor members (refer to Chapter 3 for a detailed discussion). Truss members should never be notched, drilled or cut unless the notching or drilling has been accounted for in the design of the truss.

Better Building Note
Misfitting Trusses

Trusses are designed to transfer loads at the joints of the truss. Trusses are not generally designed to transfer loads to loadbearing walls through the bottom chord as illustrated. The loadbearing wall must support the joint and be located within the scarf cut of the joint. Where trusses have been manufactured and are found to misfit the building, it is not acceptable to install them without modification.

If it is not possible to replace the misfitting truss with one which is appropriate, it may be acceptable to fit a wooden wedge above the bearing wall supports as shown. This will ensure that load is transferred to the loadbearing wall without over stressing the bottom chord of the truss. Consult the truss manufacturer regarding the acceptability of any modifications.





Modifying Misfit Truss

Note: Consult your truss manufacturer for specific design details including required nailing patterns.

Installation of Wood Trusses

Trusses are fragile building components that without care can be severely damaged. Damage most often occurs when trusses are lifted into place and loaded in a manner never intended.

For small trusses, with spans less than 6 m (19' 8"), lifting is possible from a single point. Trusses up to 9 m (29' 6") should be lifted from at least two points that are approximately a half truss span apart. The angle between the cables that lift the truss should not be more than 60° to reduce the tendency of the truss to buckle. A spreader bar and short cable slings which distribute the loads of the truss should be used to lift trusses that span to 18 m (59'). Longer trusses should be lifted with strongbacks and will require heavy lifting equipment.

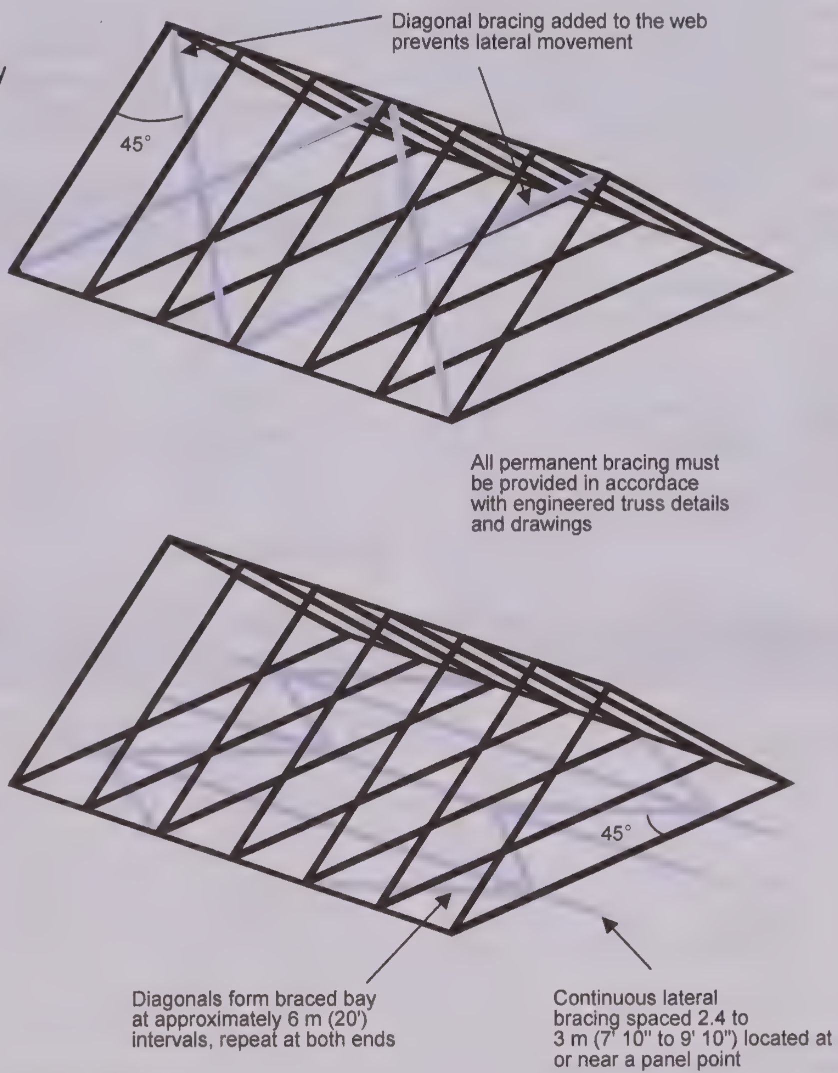
Tag lines should be used to prevent the trusses from swinging and causing damage to the structure.

Once in place trusses should be sheathed to prevent lateral buckling of the top chord. Where this is not possible, temporary bracing at the ridge and spaced every 2.4 m (7' 10") should be installed. The illustrations show typical bracing patterns.

Temporary bracing should be installed on the underside of the truss in a manner that does not interfere with the installation of roof sheathing.

Truss webs should be braced with diagonal bracing. The bottom chord can be braced with continuous lateral bracing spaced at about 2.4 m (7' 10") along the full length of the building.

Diagonal bracing applied to this lateral bracing will give the system stability. Canadian Wood Council publications should be consulted for a fuller discussion of truss bracing and installation procedures.



Bracing Trusses

ROOF SHEATHING

BUILDING CODE REFERENCES

- 9.23.3.5. Fastening for Sheathing or Subflooring
- 9.23.15.2. Material Standards
- 9.23.15.3. Direction of Installation
- 9.23.15.4. Joints in Panel-Type Sheathing
- 9.23.15.5. Lumber Roof Sheathing
- 9.23.15.6. Edge Support
- 9.23.15.7. Thickness or Rating
- 9.23.16.6. Mansard Style Roofs

Roof sheathing must conform to a number of standards which are listed in Subsection 9.23.15. of the Code. Roof sheathing that is not used as a walking deck must conform to Figure 8.12 or 8.13. If the sheathing is to be used as a walking deck then the subfloor requirements found in Chapter 3 of this Guide must be applied.

Plywood roof sheathing must be installed with the surface grain at right angles to the roof framing members. Similarly, waferboard and OSB sheathing which conforms to O-1 and O-2 grades must be installed with face orientation at right angles to roof framing. Plywood, OSB and waferboard must be installed with at least a 2 mm (3/32") gap between sheets with joints that are parallel to roof supports. This space allows for swelling of edges and can be achieved using edge support hardware.

Tongue and groove plywood is not required to have edge support; however, where panel type roof sheathing does need edge support, it must consist of 38 mm by 38 mm (2 x 2) blocking nailed between framing members or metal H clips.

Lumber roof sheathing can not be more than 286 mm (11-1/4") wide. All the ends of the lumber must be supported on solid framing and with the end joints staggered.

The requirements for fastening roof sheathing can be found in Article 9.23.3.5. When roof sheathing supports are spaced more than 406 mm (16") apart, fasteners must have a maximum spacing of 150 mm (5-7/8") along edges and intermediate supports, see Figure 8.14.

Looking Back

See Chapter 3 Flooring Systems

Rating for Roof Sheathing When Applying CAN/CSA O325.0

Maximum Spacing of Supports mm (in)	Panel Mark	
	Edges supported	Edges unsupported
406 (16")	2R16	1R16
508 (20")	2R20	1R20
610 (24")	2R24	1R24

Figure 8.12
Rating for Roof Sheathing (9.23.15.7.)

Minimum Thickness of Roof Sheathing (mm (in))

Maximum Spacing of Supports mm (in)	Plywood and O-2 Grade Waferboard and OSB		Waferboard and Strandboard R-1 and O-1 Grades and OSB		Lumber
	Edges supported	Edges unsupported	Edges supported	Edges unsupported	
305 (12")	7.5 (5/16")	7.5 (5/16")	9.5 (3/8")	9.5 (3/8")	17.0 (11/16")
406 (16")	7.5 (5/16")	9.5 (3/8")	9.5 (3/8")	11.1 (7/16")	17.0 (11/16")
610 (24")	9.5 (3/8")	12.5 (1/2")	11.1 (7/16")	12.7 (1/2")	19.0 (3/4")

Figure 8.13
Minimum Thickness of Roof Sheathing (9.23.15.7.)

Roof sheathing experiences greater uplift pressures than wall sheathing. Uplift failure of the roof sheathing is a common damage mechanism in wind events. Damage can result not only to the building on which the roof sheathing was installed, but the sheathing can be torn away from the roof and can damage adjacent homes during such wind events.

Roof sheathing fasteners are required to be installed at every 150 mm (5-7/8") where the sheathing supports are spaced more than 406 mm (16") apart. For each sheet of roof sheathing, this increases the number of required fasteners from 33 to 45, and provides added resistance to uplift forces.

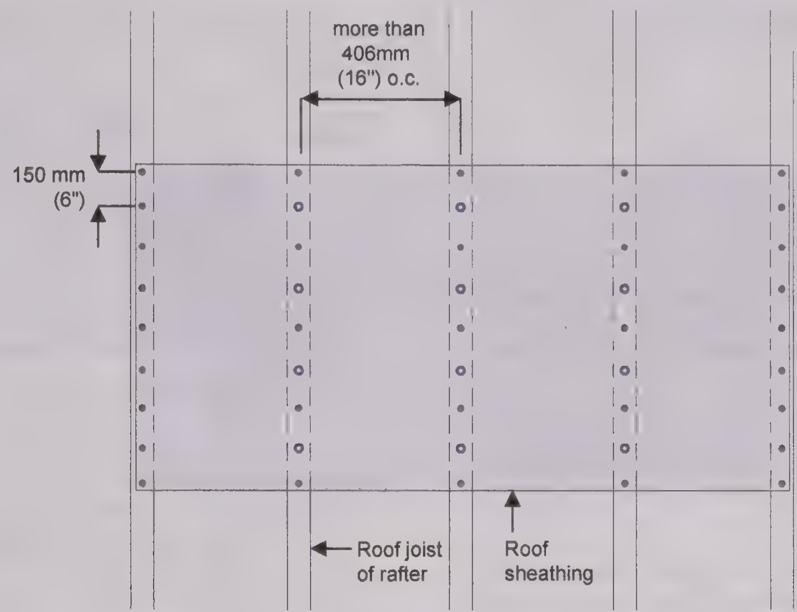


Figure 8.14
Fastening for Roof Sheathing

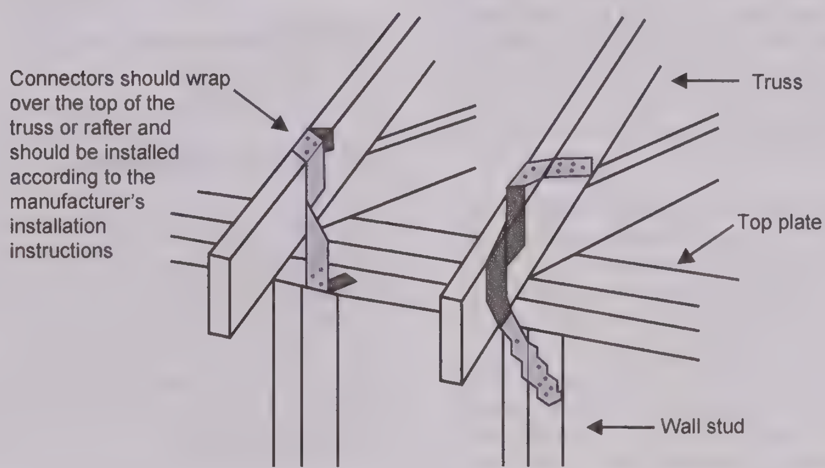
(9.23.3.5.)

Better Building Note

Bracing to Resist Uplift Loads

Unpredictable severe wind events can damage roof structures, or even cause the separation of the roof from the building. The loss of roof structure in wind storms can be a precursor to further damage to the house and danager for the occupants.

Measures can increase resistance to uplift forces during wind storms. The connection of roof rafters, joists, and/or trusses to wall framing typically requires special attention. Using connectors that are capable of resisting a factored uplift load of 3 kN will help to decrease the risk of structural damage.



ROOF AND ATTIC VENTILATION

BUILDING CODE REFERENCES

DIVISION B
9.19.1.1. Required Venting
9.19.1.2. Vent Requirements
9.19.1.3. Clearances
9.19.1.4. Mansard or Gambrel Roof

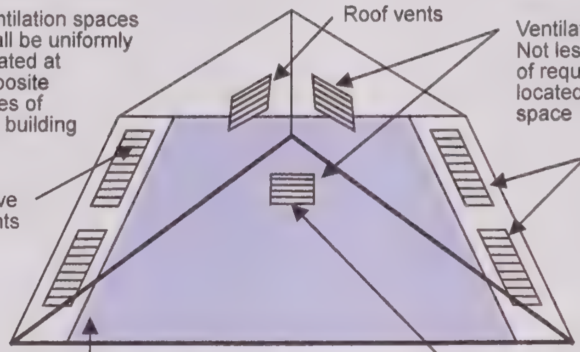
All roof or attic spaces above insulated ceilings must be ventilated by providing vents to the space between the insulation and sheathing with an unobstructed free area of 1/300 of the total insulated ceiling area. Roofs with slopes less than 2:12 and roofs without an attic space must be provided with a vent area of at least 1/150 of the ceiling area.

Roof venting should be evenly distributed along the roof and eave, front and back, and side to side to the extent possible. Required vents can be any combination of roof, eave or gable end vents, and must be designed to prevent the entry of rain, snow and insects.

The lower portion of mansard or gambrel style roofs need not be ventilated. At least 25% of the required ventilation openings for the upper portion must be provided at the junction of the upper and lower portions of the roof. Refer to Figure 8.15 and 8.17.

All roofs that do not incorporate an attic space, such as cathedral ceiling roofs, must have at least 63 mm (2-1/2") between insulation and the underside of the roof sheathing. The roof spaces must be designed to allow air to circulate evenly throughout the roof. They can be separately ventilated where roof framing members run in the same direction as the roof slope, or fitted with 38 mm x 38 mm (2 x 2) cross purlins to achieve this. Refer to Figure 8.16.

When venting is provided at the junction of sloped roofs and exterior walls and where preformed baffles are used to contain insulation, the baffles must conform to the requirements of Article 9.19.1.3. regarding the installation of insulation to conform to the venting clearances for the free flow of air. Refer to Figure 8.16.



Roof slope MORE than 2:12:
(min unobstructed ventilation area = 1:300)

Insulated ceiling area = 150 m² (1615 ft²)
Total required unobstructed vent area = 1/300 of insulated ceiling area = 0.5 m² (5.4 ft²)
At least 25%, or 0.125 m² (1.35 ft²) at both top and bottom of space

Roof slope LESS than 2:12:
(min unobstructed ventilation area = 1:150)

Insulated ceiling area = 150 m² (1615 ft²)
Total required unobstructed vent area = 1/150 of insulated ceiling area = 1 m² (10.8 ft²)
0.25 m² (2.7 ft²) at both top and bottom of space

Figure 8.15
Example of Ventilation Requirements
(9.19.1.1.)
(9.19.1.2.)

Attics and Ventilation

Attic and roof ventilation is needed in winter to remove moisture that escapes from the building interior into the cold attic or roof space. This moisture can accumulate on cold rafter or sheathing surfaces as condensation or ice and can cause potential damage. Attic ventilation is intended to remove this moisture. In summer, attic ventilation removes excess heat that can build up within the attic space.

Attic and roof ventilation can be provided by a variety of commercially available roof vents including vents that are soffit, ridge and roof mounted. Passive vents utilize wind to ventilate the attic and roof spaces.

Soffit venting is an effective ventilating method and should not be less than 50% of the total venting of the roof or attic space. Soffit venting allows air to move through the attic or roof space and also tends to positively pressurize these spaces. The positive pressurization is useful in reducing the volume of air that moves into the space from the interior of the building - air which is laden with moisture which can accumulate on cold surfaces. Ridge and roof venting tend to depressurize the attic and should not be installed without adequate soffit venting. Depressurization of the attic or roof space can draw interior air into the space increasing attic moisture problems.

Goose neck vents are often installed on flat roofs to improve the roof space ventilation. Goose neck vents tend to depressurize the roof space and act in many ways as ridge vents. Eave venting should be installed in combination with these vents to minimize interior air movement into the roof space.

Note: when purchasing roof and soffit vents, ensure "free" vent area and not gross vent area meet the requirements for attic and roof ventilation.

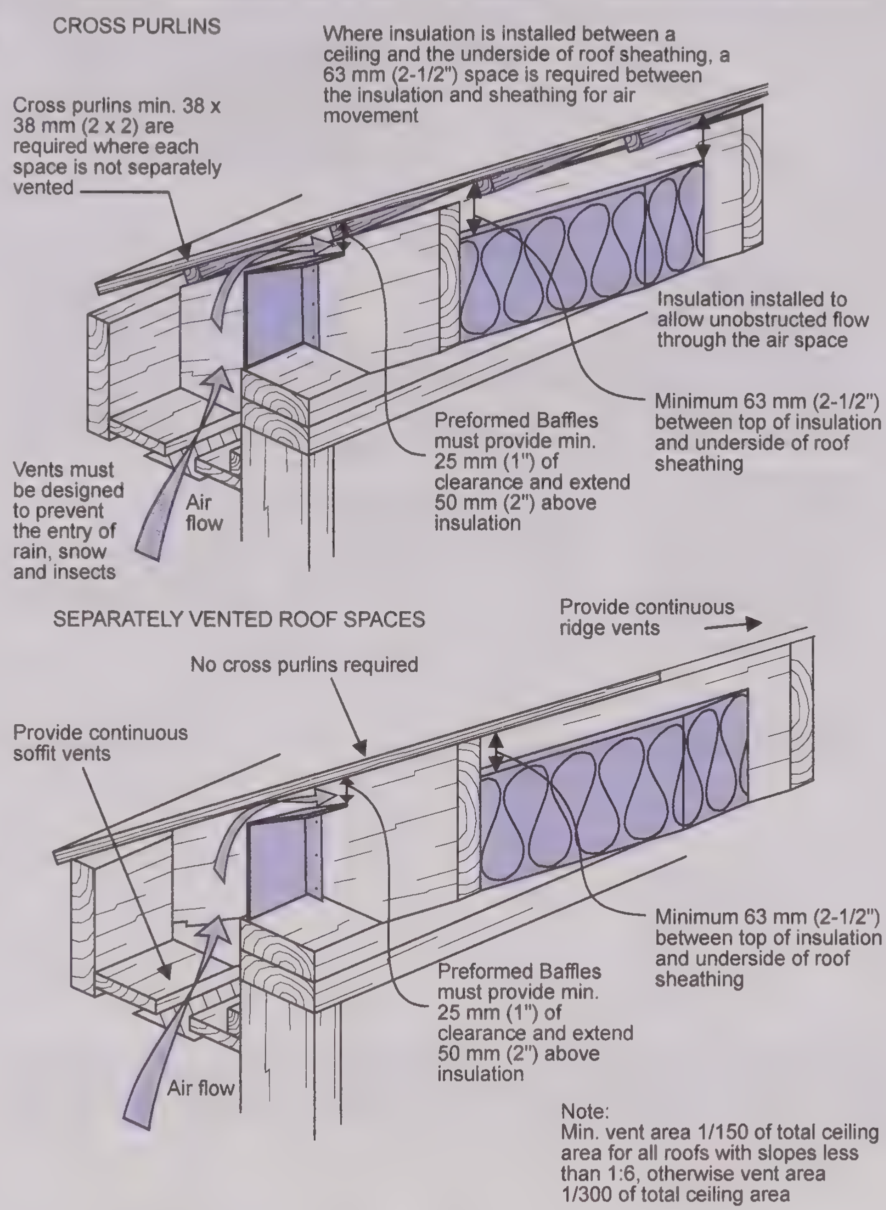


Figure 8.16
Ventilation for Roofs With Roof Joists (No Attic Space) (9.19.1.2.) (9.19.1.3.)

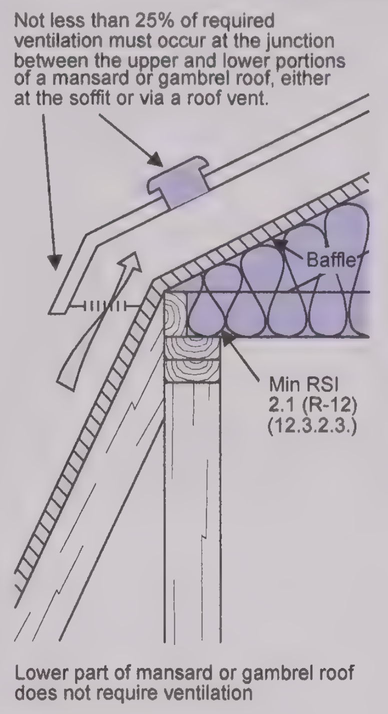


Figure 8.17
Mansard or Gambrel Roof Ventilation (9.19.1.4.)

ACCESS

BUILDING CODE REFERENCES

DIVISION B
9.19.2.1. Access

Every attic must be accessible by a hatchway where the attic space is more than 10 m^2 (108 ft^2) in area, and is not less than 600 mm (23-5/8") in height, and 1 m (3' 3") in length or width, or if the attic contains a fuel fired appliance. Small attics, with an area less than 10 m^2 (108 ft^2) and where the distance from the top of the ceiling joists to the underside of the rafters at the highest point of the attic is less than 600 mm (23-5/8") are not required to be accessible.

Hatchways into the attic should be large enough to permit a person to comfortably enter the attic and must have an area of at least 0.32 m^2 (3.4 ft^2) with no dimension less than 545 mm (21-1/2") or be not less than 500 mm by 700 mm (19-3/4" x 27-1/2") as illustrated in Figure 8.18. Hatchways serving more than a single family dwelling unit must be not less than 550 mm by 900 mm (21-5/8" x 2' 11"). Hatchways to attic or roof spaces must be fitted with doors or covers and where they are part of an air barrier system with weatherstripping. See Figure 8.18.

The dimensions for attic access as provided for in the Building Code are minimum dimensions. Where a fuel fired appliance is to be located in the attic, a larger access opening must be provided in conformance with the Gas Utilization Code or other applicable installation codes.

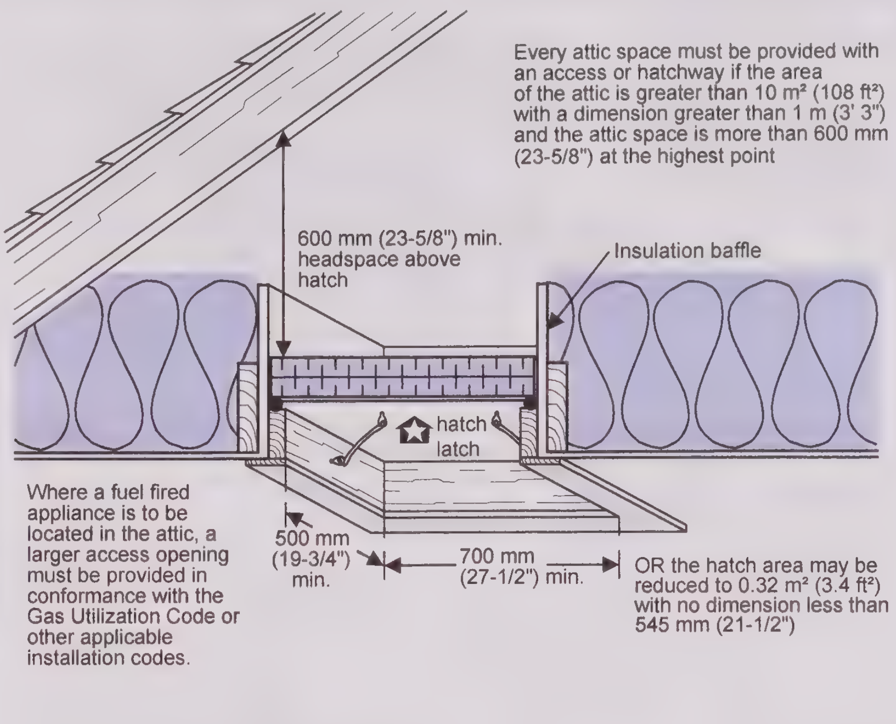


Figure 8.18
Attic Hatch Serving One Dwelling Unit (9.19.2.1.)

ROOFING

BUILDING CODE REFERENCES

DIVISION B

Exterior roof finishes must effectively shed rain from all roofs and prevent water, caused by ice damming or wind-driven rain, from penetrating into the roof space. Roofs also include platforms that may serve as roofs with respect to the accumulation or drainage of precipitation. The focus of this chapter is to outline Code requirements for roofing methods and materials, and to offer a helpful commentary on common problem areas.

There are a large number of standards for roofing materials and installation referenced in the Code. Many roofing materials may require more information prior to design and construction than provided in this guide. It is advisable to consult the relevant standards for any materials that are not discussed in this Guide.

The requirements for common material applications and their respective slope limitations are discussed in Subsection 9.26.3. of the Code.

Always check the adequacy of roof framing to support the loads imposed by roofing materials. For instance, clay tile roofs may require additional structural reinforcement to support the loads from the roofing material.

Minimum Dimensions for Roof Fasteners (mm (in))

Nails**	Head Diameter	Shank Thickness	Length
Asphalt shingles	9.5 (3/8")	2.95 (1/8")	12 * (1/2")
Wood shakes and shingles**	4.8 (3/16")	2.0 (3/32")	12 * (1/2")
Staples**	**Crown width**	**Thickness or Diameter**	**Length**
Asphalt Shingles	25 *** (1")	1.6 (1/16")	19 (3/4")
Wood shakes and shingles**	9.5 (3/8")	1.6 (1/16")	29 (1-3/16")

Notes:
* Minimum penetration into roof sheathing
** All roofing fasteners must be corrosion resistant. Wood roofing requires fasteners made of aluminum or stainless steel, except nails may also be hot-dipped galvanized
*** May be 11 mm (1/2") if shingles are fastened with at least 6 staples, located at least 25-40 mm (1 to 1-1/2 ") from each end of each strip shingle and spaced evenly between, and not less than 12 mm (1/2") above the tops of the cutouts in accordance with 9.26.7.4.

Figure 8.19
Requirements for Roof Fasteners (9.26.2.2.) (9.26.2.3.)

General

Asphalt shingle applications not described in this section of the Guide may be permitted provided that they comply with CAN3-A123.51, "Asphalt Shingle Applications on Roof Slopes 1:3 and Steeper", or CAN3-A123.52, "Asphalt Shingle Applications on Roof Slopes 1:6 to Less than 1:3".

Nails and Staples

Nails must comply with CSA B111, "Wire Nails, Spikes and Staples". Nails and staples that are used for wood shakes and shingles are required to be made of stainless steel, aluminum, or hot dipped galvanized steel (nails only). Figure 8.19 outlines the sizing criteria for nails and staples.

Roof Slope

Roofs and elements acting as roofs should be constructed with sufficient slope away from exterior walls and guards (connected to the roof by more than posts or pickets). Roofs should maintain a positive slope after the building frame shrinks and the design load is applied for cantilevered roofs. These requirements can be ignored where it can be shown that water from negative or back slopes will not adversely affect supporting elements or adjacent supported elements. Maintaining a positive roof slope will minimize the possibility of water ingress to supported or supporting elements that may cause premature roofing failure.

The table in Figure 8.20 lists the minimum and maximum roof slopes permitted for common roof types. Note that asphalt and gravel or coal tar and gravel roofs may be of a lesser slope provided that roof drains are installed at the lowest point on the roof. Metal roofing systems designed specially for lower slopes may also be applied if they are installed according to the manufacturer's written instructions.

Roofing Types and Slope Limits of Roofs

Type of Roofing	Minimum Slopes	Maximum Slope
Built-up Roofing		
Asphalt base (gravelled)	1 in 50*	1 in 4
Asphalt base (without gravel)	1 in 25	1 in 2
Coal-tar base (gravelled)	1 in 50*	1 in 25
Cold process	1 in 25	1 in 1.33
Clay Shakes	1 in 3	no limit
Asphalt Shingles		
Normal application	1 in 3	no limit
Low slope application	1 in 6	no limit
Roll Roofing		
Smooth and mineral surface	1 in 4	no limit
Selvage asphalt roofing 480 mm wide	1 in 6	no limit
Cold application felt	1 in 50	1 in 1.33
Wood Shingles	1 in 4	no limit
Asbestos-Cement Corrugated Sheets	1 in 4	no limit
Profiled Metal Roofing	1 in 4	no limit
Profiled Metal Shingles	1 in 4	no limit
Slate Shingles	1 in 2	no limit
Clay Tile	1 in 2	no limit
Glass Fibre Reinforced Polyester Roofing Panels	1 in 4	no limit
Modified Bituminous Membranes	1 in 50	1 in 4

* May not be used in conjunction with Type I expanded polystyrene insulation.

Note: Asphalt and gravel or coal tar and gravel roofs may be constructed with lower slopes than required by Figure 8.17 when effective drainage is provided by roof drains located at the lowest points on the roofs.

Profiled metal roof cladding systems specifically designed for low-slope applications are permitted to be installed with lower slopes than 1 in 4 provided they are installed with the manufacturer's wrttien instructions.

Figure 8.20
Roofing Types and Slope Limits of Roofs (9.26.3.1.)

Flashing

The installation of flashing is intended to provide protection for joints, corners, and material intersections and to ensure the integrity of the roof as a water-shedding surface. Flashing is required at the junction between roofs and walls that rise above the roof. Flashing must also be applied between roofs and guards that are connected to the roof by more than posts or pickets. Flashing materials in roof surfacing applications must comply with the requirements set out in Figure 8.21.

When roofing planes intersect to form a valley, the intersection must be flashed even when continuous sheathing is used. Flashing in a closed valley, where the flashing is not exposed, must be sheet metal, composite membranes (such as polyethylene and bitumen), one layer Type S roll roofing, or one layer Type M mineral surface roll roofing.

Flashing in an open valley, where the flashing is exposed, must be either sheet metal or a layer of Type S smooth roll roofing or Type M mineral surfaced roofing topped with a second layer of mineral surfaced Type M in accordance with the sizing and attachment requirements illustrated in Figure 8.22.

Materials

Material	Minimum Thickness mm (mil)
Sheet Lead	1.73 (68)
Galvanized Steel	0.33 (13)
Copper	0.33 (13)
Zinc	0.35 (14)
Aluminum	0.48 (19)

Figure 8.21
Materials (9.26.4.2.)

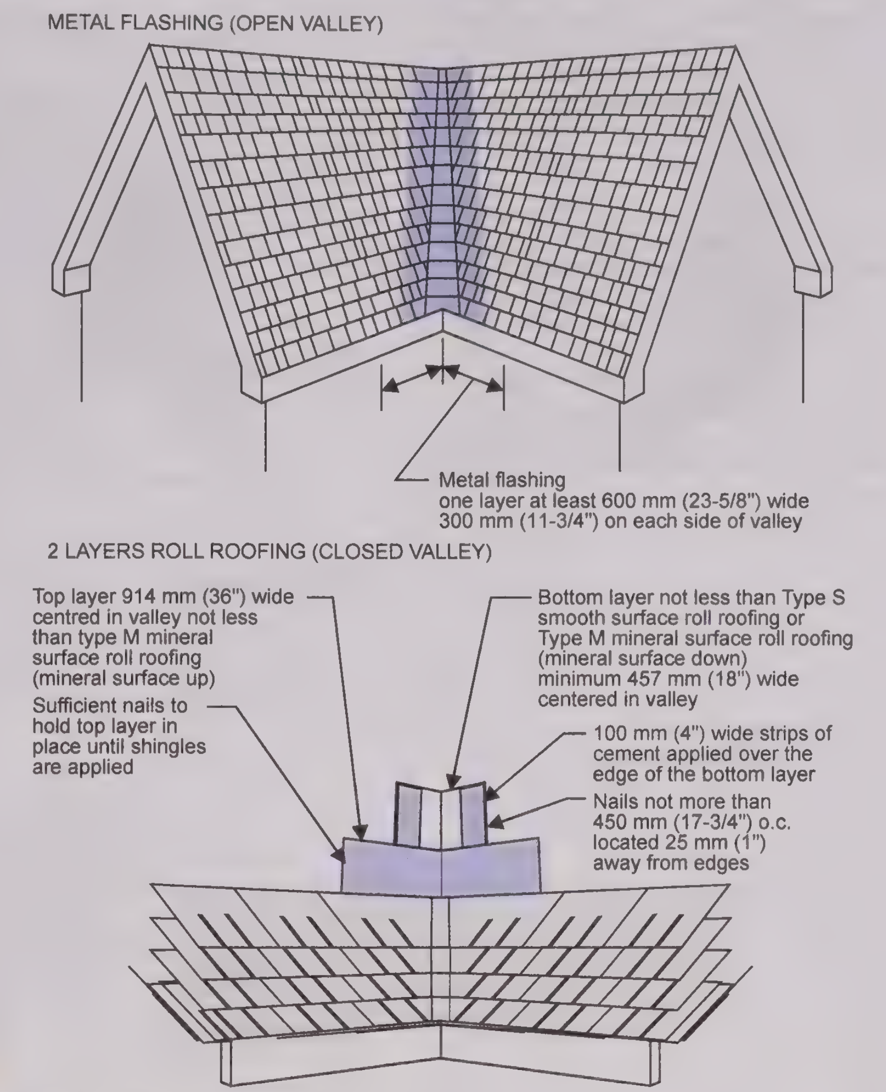


Figure 8.22
Valley Flashing (9.26.4.3.)

The intersection of shingle roofing and masonry, including chimneys and parapets, requires flashing. Figures 8.23 to 8.26 include a number of details with minimum dimensional requirements for flashing at the edge of a slope and at the top and the bottom of a slope.

It is very important that a roof sloping away from a masonry wall is flashed to the inside up under the sheathing paper to ensure that any condensation within the wall is shed out onto the roof.

A roof must not slope directly perpendicular into a wall. It may slope at an acute angle to it to ensure that water will not collect and leak into the roof space.

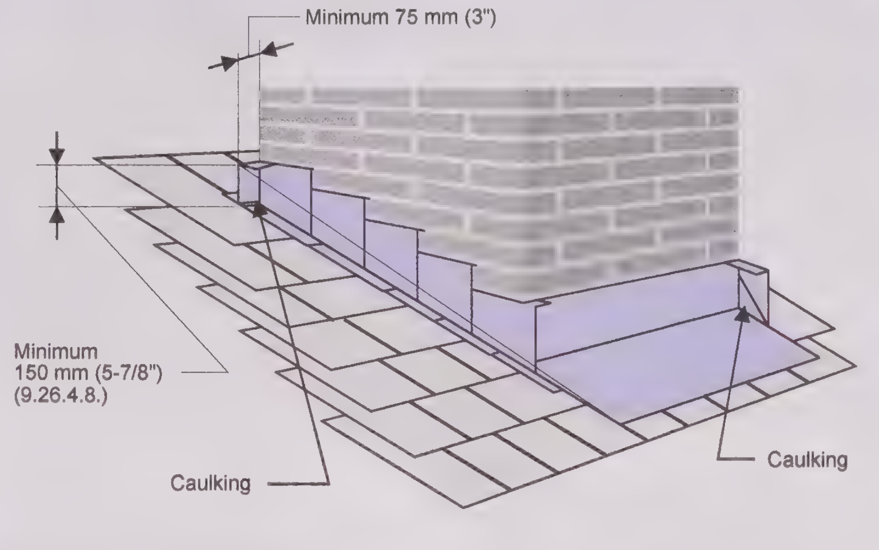


Figure 8.23
Chimney Flashing (9.26.4.4.)

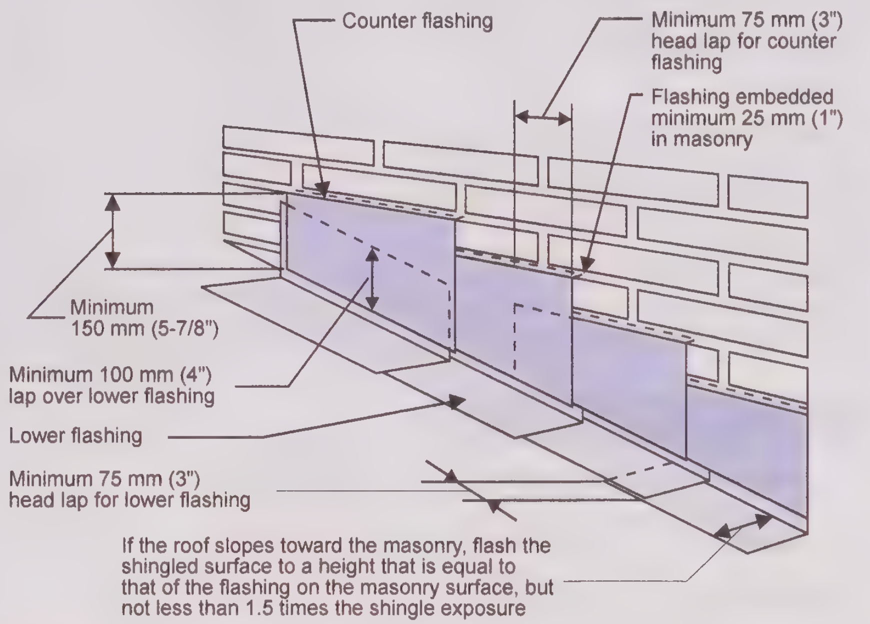


Figure 8.24
Step Flashing at Intersection of Shingle Roof and Masonry (9.26.4.4.)

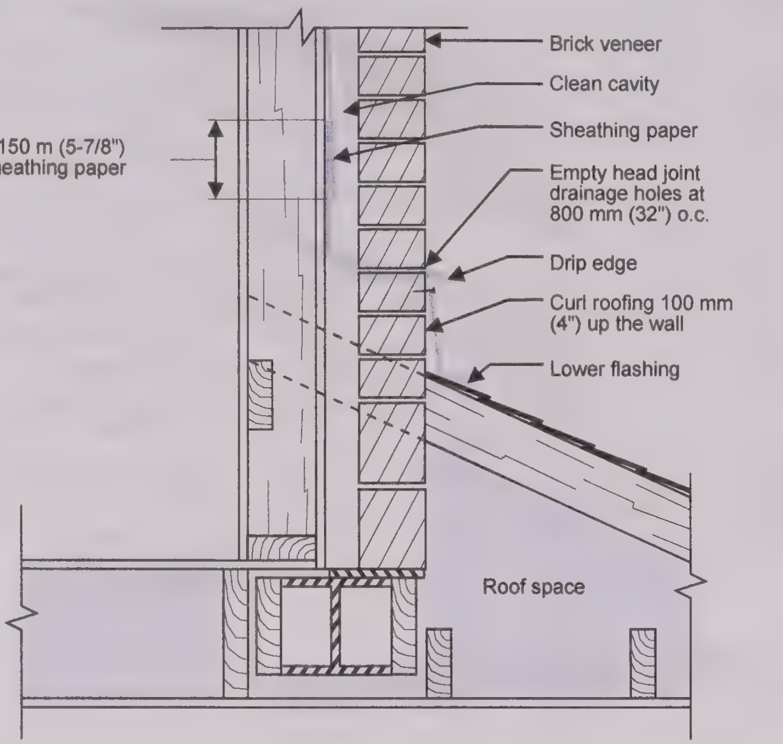


Figure 8.25
Flashing of Roof Sloping Away from Masonry Wall (9.26.4.4.)

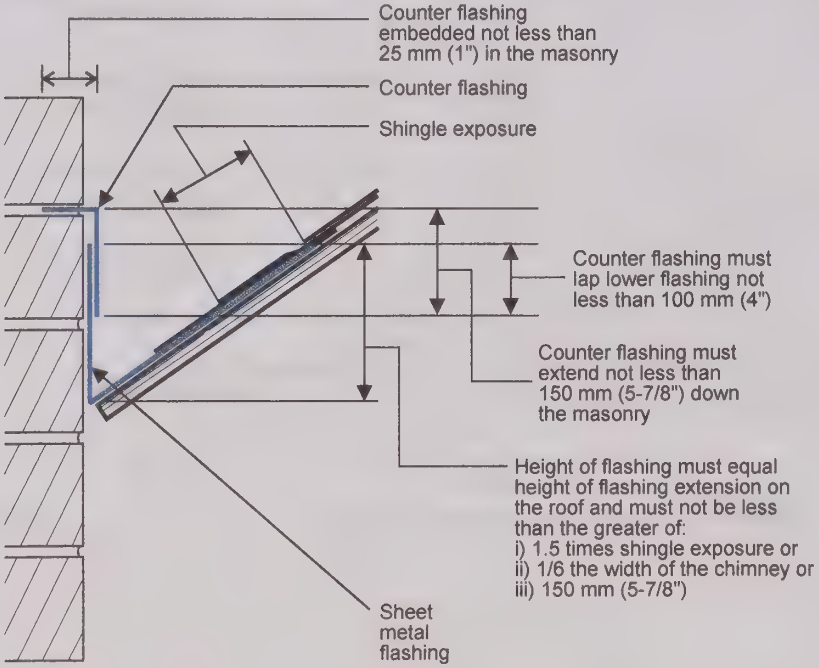


Figure 8.26
Roof Slopes Upward from Chimney (9.26.4.4.) (9.26.4.8.)

Where shingle roofs intersect with siding or stucco finish the flashing must be installed up behind the sheathing paper. Figure 8.27 shows the required lapping of the flashing and the minimum dimensions to ensure good water protection.

The intersection of built-up roofs with masonry walls and chimneys must have a cant strip. The roofing material is then mopped up over the strip up the wall at least 150 mm (5-7/8"). Flashing must be embedded into the wall as shown in Figure 8.28 to the minimum dimensions shown.

Intersections of built-up roofs and siding or stucco finishes must be provided with a cant strip and the bitumen mopped up onto the sheathing beneath the sheathing paper at least 150 mm (5-7/8") above the cant strip as shown in Figure 8.29.

Flashing for the edge of built-up roofs is presented in Built-Up Roofing later in this Chapter of the Guide.

Chimneys are required to have saddles constructed in conformance with requirements found in Article 9.26.4.7. of the Code, if they are at least 750 mm (30") wide facing the direction of the roof slope. Figure 8.30 illustrates the flashing methods for chimney saddles. Flashing for chimneys that are not wider than 750 mm (30") must be flashed as is also described above for masonry intersecting a downward sloping roof.

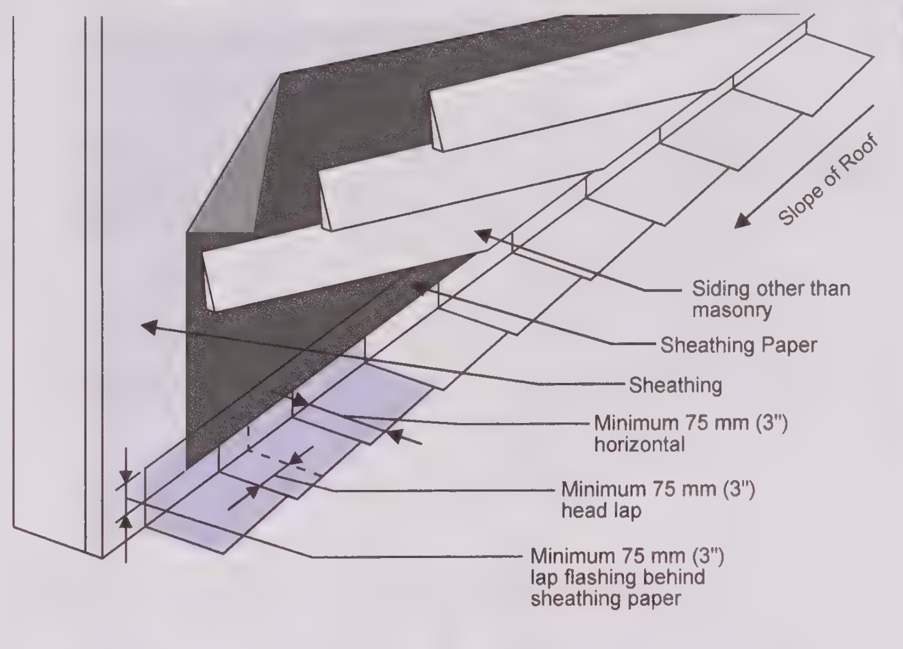


Figure 8.27
Intersection of Shingle Roofs with Siding (9.26.4.5.)

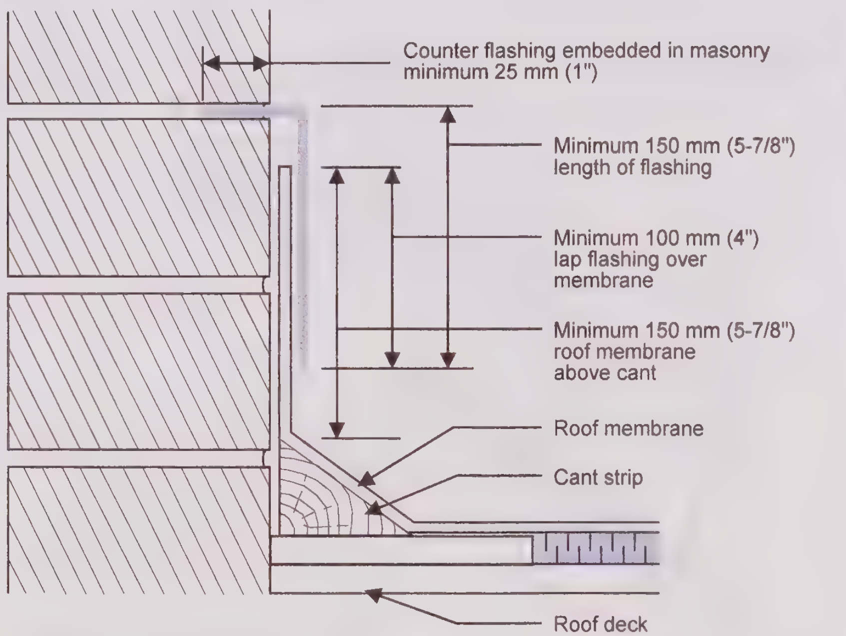


Figure 8.28
Intersection of Built-Up Roofs with Masonry Walls (9.26.4.6.)

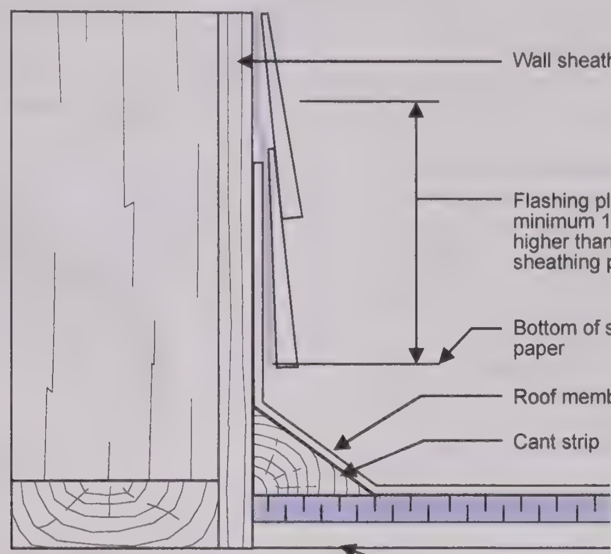


Figure 8.29
Intersection of Built-Up Roofs with Non-Masonry Walls (9.26.4.7.)

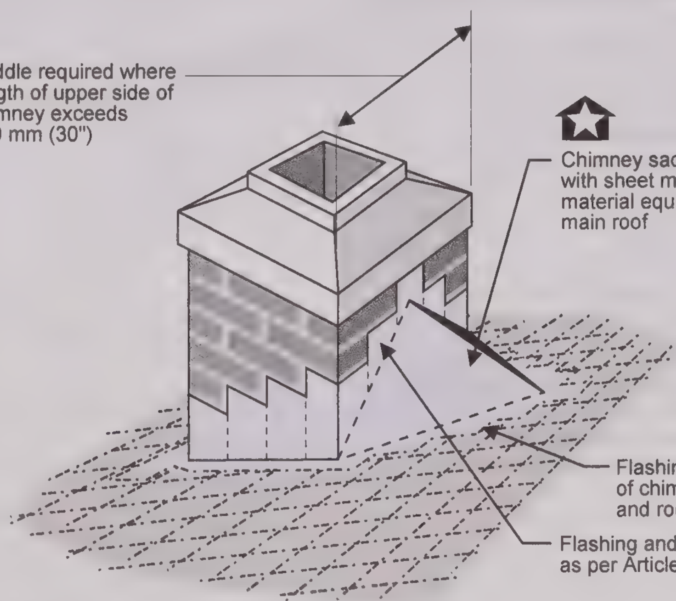


Figure 8.30
Chimney Saddle (9.26.4.8.)

Eave Protection and Underlay for Shingles and Shakes

Eave protection that complies with Figure 8.31 is required unless:

- it is over an unheated garage or where the roof extends more than 900 mm (2' 11") from the interior wall face to the edge of the roof measured along the roof slope,
- the roof slope is less than 1:3 and asphalt shingles are laid in cement, or the roof slope is greater than 1:1.5, or
- the building is sited in a region with 3500 degree days or less.

Materials for use as eave protection can be one of:

- No. 15 asphalt-saturated felt laid in two plies lapped at least 480 mm (18-7/8") and cemented together,
- Type M or S Roll roofing lapped at least 100 mm (4") and cemented together,
- glass fibre or polyester based sheets, or
- self-sealing composite membranes coated with a modified bituminous material.

Underlay for shingles and shakes when used must be:

- an asphalt-saturated sheathing paper of at least 0.195 kg/m^2 (4 lbs/100 ft^2),
- No. 15 plain or perforated asphalt-saturated felt, or
- underlay for wood shingles and shakes must be a breathable type.

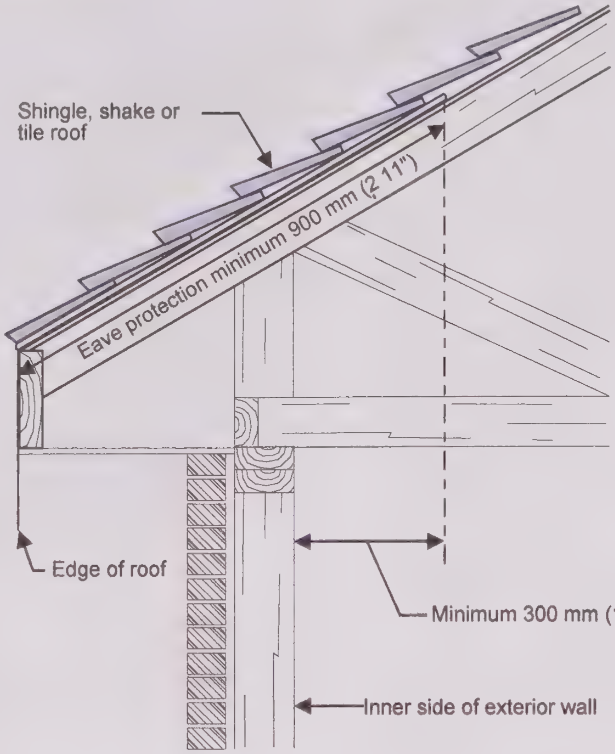


Figure 8.31
Eave Protection (9.26.5.1.)

Asphalt Roof Shingles

Slopes greater than 1:3

Roofs with a slope of 1:3 or greater require that shingles be laid at least 2 shingles thick over the entire roof surface not including cutouts. No fewer than 4 fasteners must be provided for every 1 m (3' 3") of shingle width. A narrower shingle requires proportionately fewer fasteners. Fasteners may also be reduced when shingles incorporate interlocking devices. All fasteners must be located within 25 mm (1") to 40 mm (1-9/16") of the edge of the shingle and at least 12 mm (1/2") away from any cutaways or cutouts. Head laps for asphalt shingles are a minimum of 50 mm (2"). Refer to Figure 8.32 for illustrations of these requirements.

Starter strips must conform to the illustration in Figure 8.33 except that starter strips may only be omitted if the eave protection is not less than a Type M mineral faced roll or a composite polyethylene bituminous self-sealing membrane.

All shingle tabs must be secured with spots of plastic cement not greater than 25 mm (1") in diameter under the centre of each tab as shown in Figure 8.32. This requirement is satisfied by using self-sealing shingles. Any approved interlocking device would also be sufficient.

Shingles at hips and ridges must extend 100 mm (4") on both sides of the centreline and must be lapped at least 150 mm (5-7/8") to ensure a tightly fit edge that will not be pulled away. Shingles on ridges and hips must be fastened within 25 mm (1") of the edges and the exposure line of the butt end of the next higher course of shingles.

Better Building Note

Normal sloped roofs can have low sloped sections at hips or valleys, appropriate application of shingles in these low slope situations is necessary.

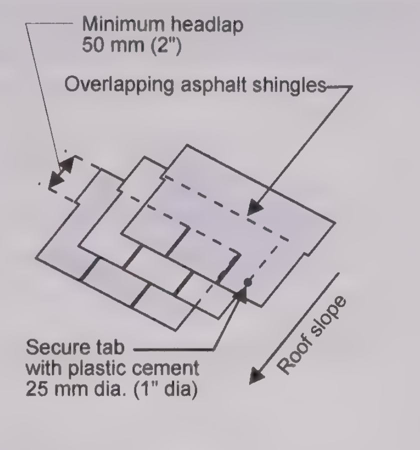


Figure 8.32
Securing of Tabs (9.26.7.5.)

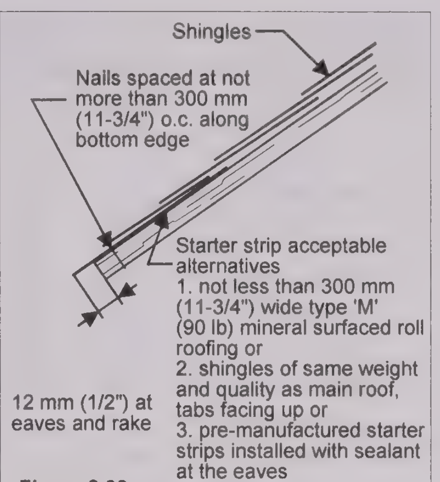


Figure 8.33
Starter Strip (9.26.7.2.)

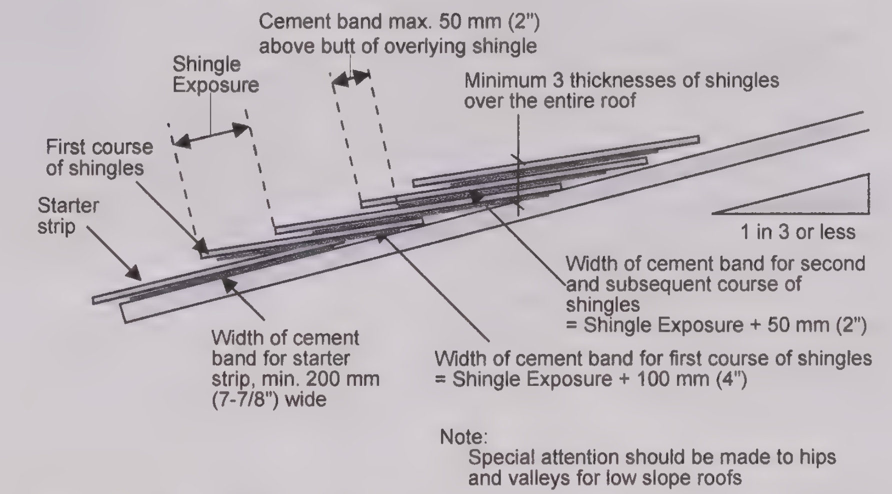


Figure 8.34
Asphalt Shingles on Slopes of Less Than 1:3 (9.26.8.)

Slopes less than 1:3

Asphalt shingles applied to roofs on a slope of less than 1:3 are required to be at least 3 shingles thick over the entire roof not including cutouts. Starter strips must be the same as for roofs of greater than 1:3 slope, but the starter strip material must be embedded in a cement band at least 200 mm (7-7/8") wide. The first shingle course must be secured with a continuous band of cement that conforms to Figure 8.34. The successive courses are also attached with cement. All tabs for the shingles must be secured with a cold application of cement of 0.5 L/m^2 (1 Gal/100 ft^2) of cemented area or a hot application of asphalt of 1 kg/m^2 (0.21 lbs/ft^2) of cemented area.

Shingles applied on hips and ridges must be at least 300 mm (11-3/4") wide providing triple coverage and should be centred. The shingles must be cemented with fasteners located at least 40 mm (1-9/16") from the butt end of the overlying shingle and 50 mm (2") from the edge.

Insulated asphalt siding applications require a 10 mm (3/8") air space behind them to provide ventilation. Refer to Chapter 13, Insulation, Air Barriers and Vapour Barriers of this guide for further information.

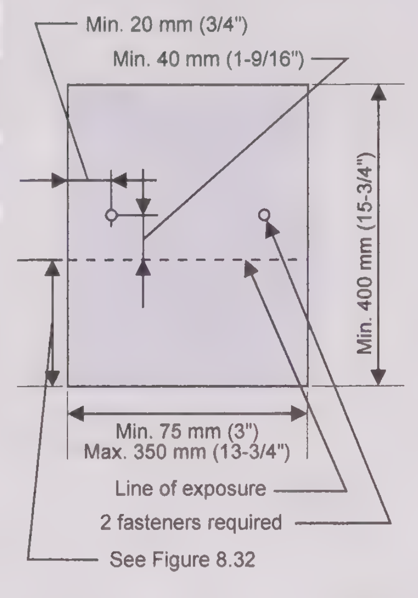


Figure 8.35 (9.26.9.3.)
Sizing and Fastener Requirements for Wood Shingles (9.26.9.5.)

Wood Roof Shingles

Decking for wood roof shingles must be continuous or spaced. The shingles must be of No.2 grade or better. The sizing and requirements for fasteners must conform to Figure 8.35. The exposure for the shingles must comply with Figure 8.36.

Cedar Roof Shakes

Dimensional requirements and maximum exposure for cedar roof shakes must conform to Figure 8.36. If eave protection is not provided, an underlay that conforms to the requirements of Subsections 9.26.5. and 9.26.7. (elaborated on in Eaves Protection & Underlay for Shingles & Shakes earlier in this Chapter) must be provided not less than 900 mm (2' 11") in width along the eaves. A strip of interlay material at least 450 mm (17-3/4") wide must be provided between each course of shakes as shown in Figure 8.37. These interlayed strips must be lapped at least 150 mm (5-7/8") on ridges and hips to prevent any penetration of rain water due to ice damming or wind driven rain. The grade of cedar roof shakes must be not less than No.1 or Handsplit grade. The fastening of shakes and the spacing and offsetting of joints must conform to Figure 8.38.

Maximum Exposure of Wood Shingles (mm (in))

Roof	No. 1 or A Grade Length of Shingle			No.2 or B Grade Length of Shingle		
	400 mm (15-3/4")	450 mm (17-3/4")	600 mm (23-5/8")	400 mm (15-3/4")	450 mm (17-3/4")	600 mm (23-5/8")
less than 1 in 3	100 (4")	115 (4-1/2")	165 (6-1/2")	90 (3-1/2")	100 (4")	140 (5-1/2")
1 in 3 or more	125 (5")	140 (5-1/2")	190 (7-1/2")	100 (4")	115 (4-1/2")	165 (6-1/2")

Figure 8.36
Maximum Exposure of Wood Shingles (9.26.9.6.)

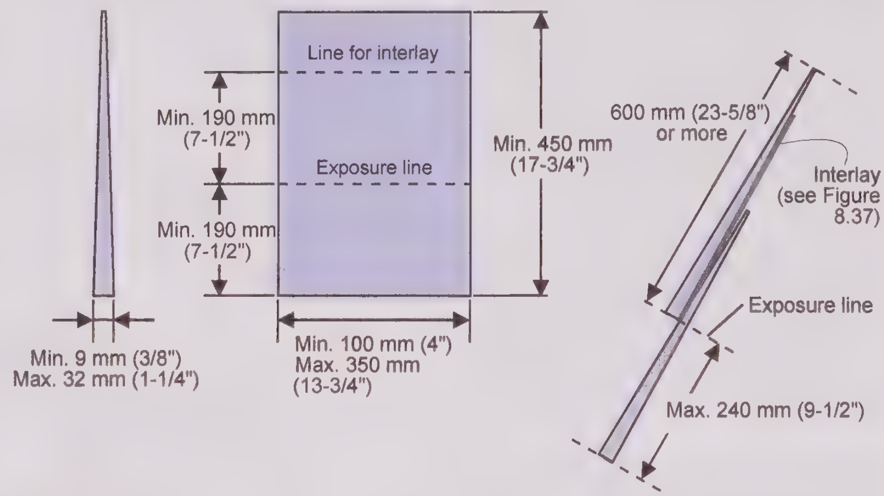


Figure 8.37
Sizing of Cedar Shakes (9.26.10.)

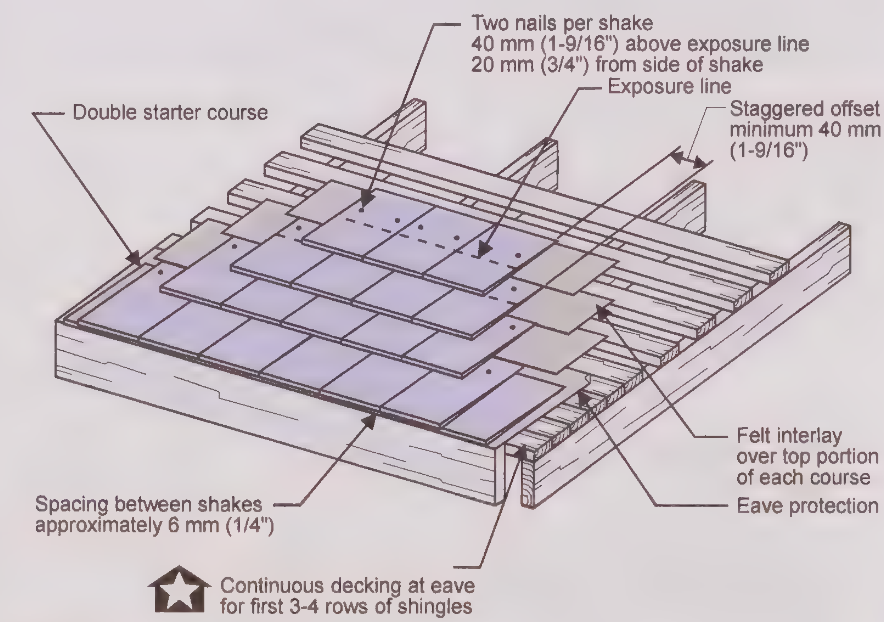


Figure 8.38
Shake Application (9.26.10.)

Built-Up Roofing

Materials for all built-up roofs must conform to the values listed in Figure 8.39. Coal-tar and asphalt products must not be used together in construction. All bitumen felts must be at least of No.15 weight or better. Aggregate used for surfacing must be clean, dry, and durable and may be gravel, clear stone, or air-cooled blast furnace slag between 6 mm (1/4") to 15 mm (5/8") in size. At least 15 kg (33 lbs) of gravel or clear stone or 10 kg (22 lbs) of crushed slag must be used to cover each square metre (10.76 ft²) of roof surface area.

Built-up roofs must have at least 3 continuous layers of felt mopped down with bitumen. Felt must be laid free of any wrinkles and rolled directly onto the hot bitumen so that the felt is completely coated such that no 2 layers of felt touch each other directly. Rolls must overlap to guarantee each individual layer is continuous.

Built-up roofing application onto wood sheathing requires that either a base layer of felt lapped a minimum of 50 mm (2") is applied without hot bitumen as shown in Figure 8.40 or the joints of all the sheathing boards must be taped and primed with asphalt.

Roofing applied to decking and insulation must be secured before any felt and bitumen is applied.

Cant strips must be provided at the edge of all roofs unless a gravel stop is installed. At least 2 layers of roofing must extend up over the edge of the cant strip and be suitably flashed with a drip shown in Figure 8.41, or a gravel stop must be installed. Other flashing requirements can be found under the heading Flashing in this Chapter.

Amount of Bitumen per Square Metre of Roof Surface for Built-up Roofs

Type of Roof	Mopping Coats Between Layers	Flood Coat
Asphalt and aggregate	1 kg (2.2 lbs)	3 kg (6.6 lbs)
Coal-tar and aggregate	1.2 kg (2.6 lbs)	3.6 kg (7.9 lbs)
Cold process roofing	0.75 L (0.16 Gal) cold process cement	2 L (0.44 Gal) cold process top coating

Figure 8.39
Bitumen for Built-up Roofs (9.26.11.1.)

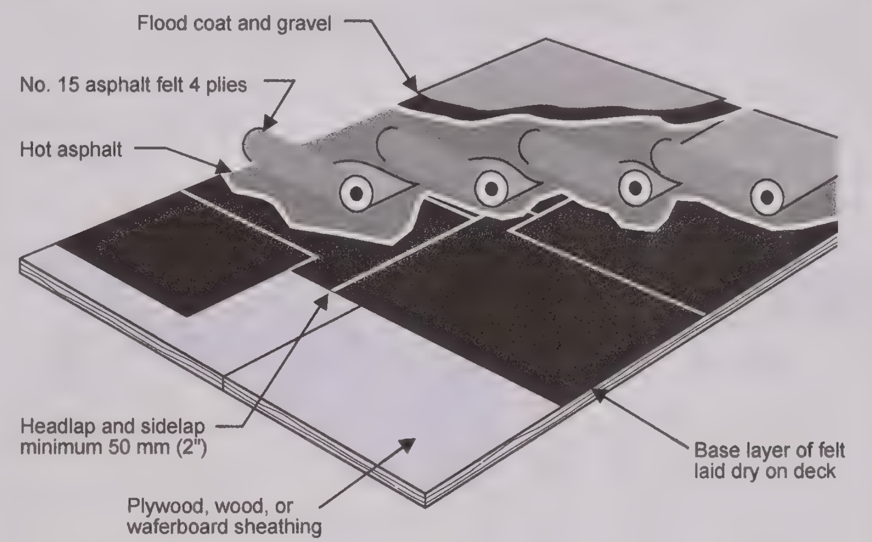


Figure 8.40
Organic Built-up Roofing (9.26.11.)

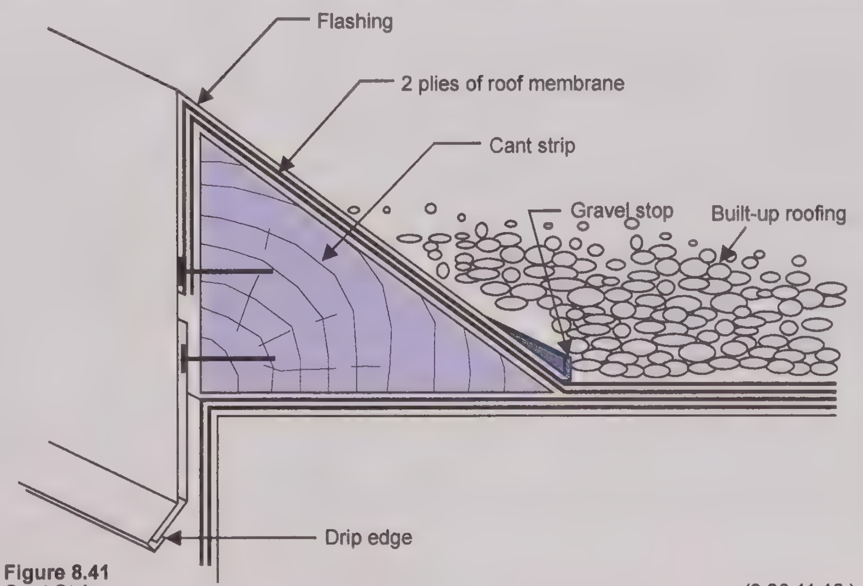


Figure 8.41
Cant Strip (9.26.11.10.)

Selvage Roofing

Selvage asphalt roofing must be installed to provide a double layer of coverage over the entire roof surface area. All plies must be cemented together using a bead of cement to ensure that it is watertight throughout. See Figure 8.42.

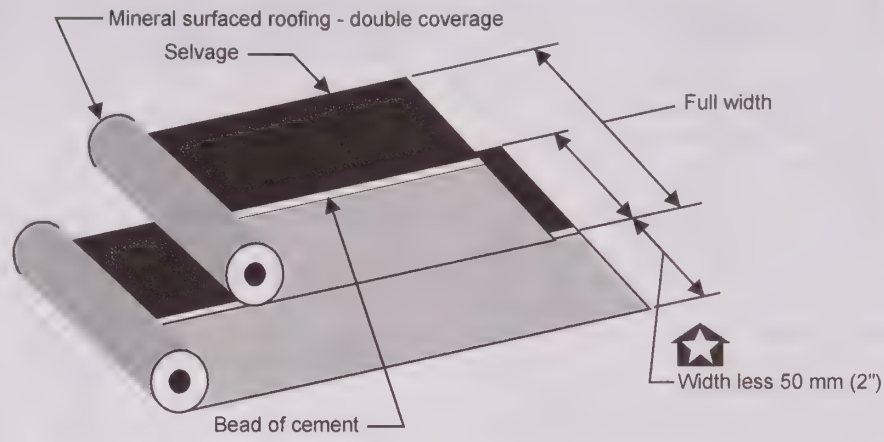


Figure 8.42
Selvage Roofing (9.26.12.)

Sheet Metal Roofing

Sheet metal roofing must conform to the thickness requirements shown in Figure 8.43. It must be securely attached and provide for effective roof drainage.

Where sheet metal roofing spans between supporting members and is not supported by the roof deck, the sheet metal must be designed to support the required live load for roofs.

Minimum Thickness

Material	Minimum Thickness mm (mil)
Galvanized Steel	0.33 (13)
Copper	0.46 (18)
Zinc	0.46 (18)
Aluminum	0.48 (19)

Figure 8.43
Sheet Metal Roofing Materials (9.26.13.1.)

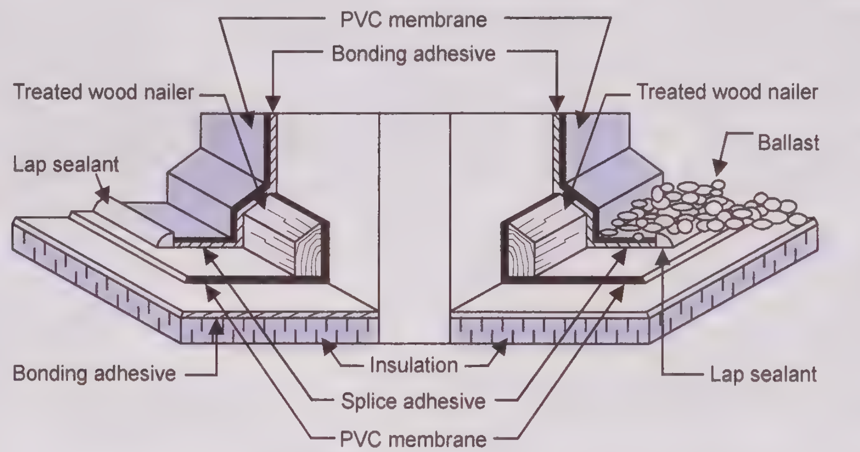


Figure 8.44
PVC Roofing (9.26.16.)

Glass Reinforced Polyester Roofing

Panels of reinforced polyester must be placed to support the designed roof load if located on roof framing without any sheathing. Additional requirements may be found in the appropriate standards and manufacturers' literature.

Hot Applied Rubberized Asphalt Roofing

Rubberized hot asphalt must be installed in conformance with CGSB 37 GP-51M, "Application for Hot Applied Rubberized Asphalt for Roofing and Waterproofing." Additional requirements may be found in manufacturers' literature.

Polyvinyl Chloride Sheet Roofing

The installation of a PVC roof membrane must conform to CGSB 37 GP-55M, "Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane." Refer to Figure 8.44.

Concrete Roof Tiles

Concrete roof tiles must be installed according to CSA-A220.1M, "Installation of Concrete Roof Tiles". Additional requirements may be outlined in manufacturers' literature.

Downspouts and Roof Drains

Where downspouts are provided and are not connected to a sewer, extensions shall be provided to carry rainwater away from the building preventing any soil from eroding near the base of the dwelling unit. When roof drains are provided they must conform to Part 7 of the Code.

WORKED EXAMPLE

Roof Construction: Using Span Tables

Example A & B - Minimum Size of Roof Rafter

Consider the following roof conditions. The building is 8 m (26' 3") wide from the outside wall to outside wall with minimum rafter spacing of 406 mm o.c. (16"). The composite load is 2.5 kPa (52.2 psf) with no concentrated loads. The lumber selected is No. 1 Grade Spruce.

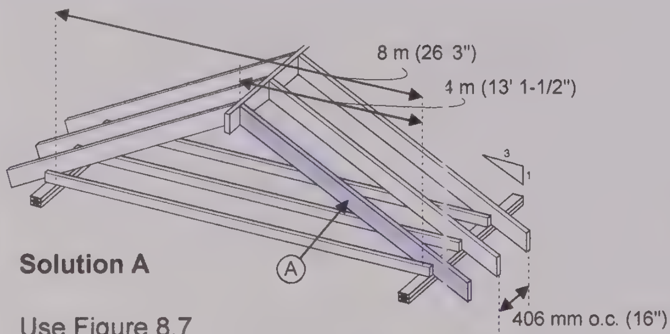
What is the required size for the roof rafter if collar ties are not provided?
A = ?

What is the required size for the roof rafter if collar ties are provided at 406 mm o.c. (16")?
B = ?

Example C - Minimum Size of Ceiling Joist

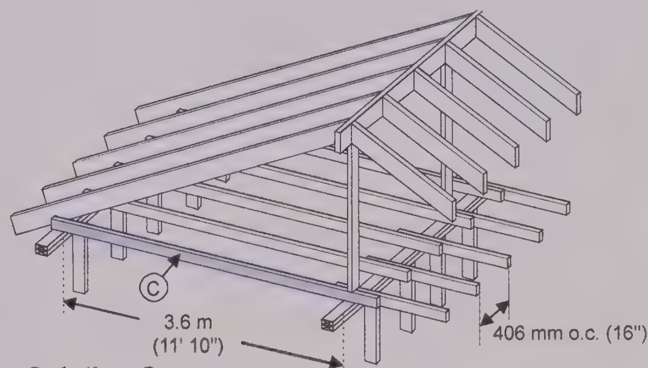
Consider the following roof conditions. The attic is not accessible from a stairway. The ceiling joist span is 3.6 m (11' 10") and the minimum spacing is 406 mm o.c. (16"). There are no concentrated loads. The lumber selected is No. 1 Grade Spruce.

What is the minimum permitted size of the ceiling joist?
C = ?



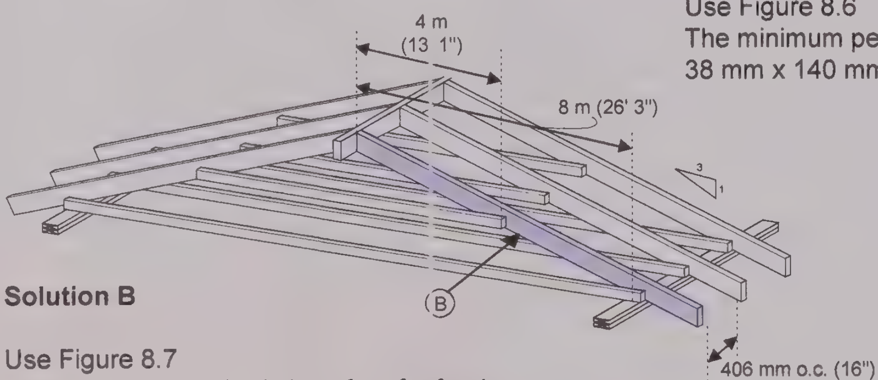
Solution A

Use Figure 8.7
The minimum required size of roof rafter is
38 mm x 184 mm (2 x 8) if collar ties are not provided.



Solution C

Use Figure 8.6
The minimum permitted size of the ceiling joist is
38 mm x 140 mm (2 x 6).



Solution B

Use Figure 8.7
The minimum required size of roof rafter is
38 mm x 89 mm (2 x 4) if collar ties are provided.

9 WINDOWS AND SKYLIGHTS

Windows provide occupants with light, ventilation and view. In emergencies they can also serve as a means of egress from the building. In winter, they are can represent significant sources of heat loss, while in summer sunlight which enters the house can significantly increase the home's air conditioning load.

KEY POINTS

Windows in residential dwellings must be designed and installed to fulfill one or more of the following functions:

- provide natural light;
- allow emergency escape from floors with bedrooms;
- resist forced entry;
- control heat loss and heat gain;
- resist air leakage;
- resist sound transmission in specific situations;
- provide acceptable thermal resistance; and
- provide natural ventilation as required.

WINDOWS

BUILDING CODE REFERENCES

DIVISION B

9.3.2.9.	Termite and Decay Protection
9.7.1.1.	Application
9.7.2.2.	Other Requirements for Windows, Doors and Skylights
9.7.2.3.	Minimum Window Areas
9.7.3.1.	General Performance Criteria
9.7.3.2.	Heat Transfer Performance
9.7.3.3.	Thermal Characteristics of Windows, Doors and Skylights
9.7.4.1.	Application
9.7.4.2.	General
9.7.4.3.	Performance Requirements
9.7.5.1.	Application and Compliance
9.7.5.3.	Resistance to Forced Entry for Windows
9.7.6.1.	Installation of Windows. Doors and Skylights
9.7.6.2.	Sealants, Trim and Flashing
9.9.10.1.	Egress Windows or Doors for Bedrooms
12.2.1.1.	Energy Efficiency Design Before January 1, 2017
12.3.1.2.	Windows and Sliding Glass Doors

The following commentary and illustrations detail many of the window and skylight provisions of the Code.

WINDOW STANDARDS

Windows and skylights installed as part of an assembly separating heated and non-heated space must be able to resist the ingress of precipitation and insects, resist wind loads, control air leakage, resist forced entry (where required), and are easily operable when not fixed. Skylights must also be able to resist snow loads.

A variety of standards affecting the manufacturing and testing of windows are identified in the Code. CAN/CSA-A440.4, "Window, Door and Skylight Installation", CAN/CSA-A440.2 "Fenestration Energy Performance" and CSA A440S1, "Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights", are the key standards that are referenced in the Code.

Windows must be installed in accordance with CAN/CSA-A440.4, except that treated plywood shims are permitted to be used as support, and cladding for walls that a window is installed in must comform to Section 9.27. Cladding. Windows must be sealed to both air and vapour barriers.

A great number of windows are available commercially from an even greater number of manufacturers and suppliers. Many windows have been tested, with test data readily available (see Canadian Construction Materials Centre - Evaluation Listings). This data should be used when making window selection decisions. The manufacturers' installation instructions must be followed when installing pre-manufactured windows. Some common window types are illustrated in this chapter.

MINIMUM WINDOW AREAS

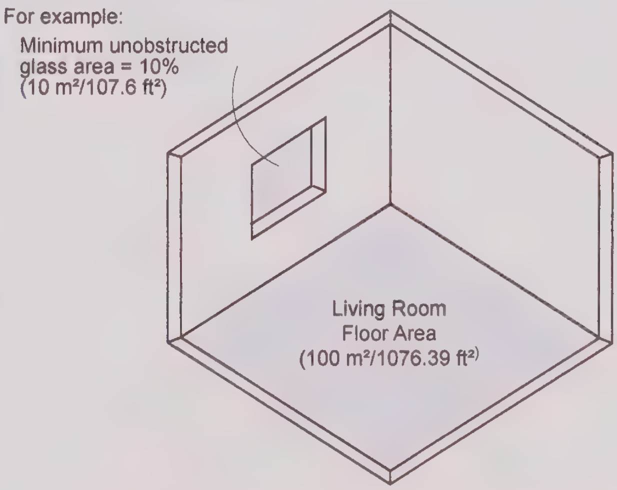
Windows must be provided in rooms where lighting is limited by the lack of electric lighting or where natural lighting is needed.

Laundry rooms, basement recreation rooms and unfinished basements, for instance, do not require windows where electrical lighting is provided. However, where no electric lighting is available, the unobstructed glass area must be 4% of the floor area served. Water closet rooms must be provided with no less than 0.37 m^2 (4 ft^2) of unobstructed glass area where electric lighting is unavailable, while for kitchens it must be no less than 10% of the floor area served.

Living rooms and dining rooms require windows with an unobstructed glass area of no less than 10% of the floor area served irrespective of whether electrical lighting is provided. Similarly, bedrooms also require windows with an unobstructed glass area of no less than 5% of the floor area whether served by electric lighting or not. In these rooms, because of occupancy needs, natural lighting is desirable and a minimum area of glazing is required without regard to the availability of lighting from other sources.

When two or more rooms with different requirements for window glass area are considered as a combination room,

Minimum Unobstructed Glass Area	
Location	**With Electric Lighting**
Laundry, basement recreation room, unfinished basement	Windows not required
Water-closet room	Windows not required
Kitchen, kitchen space, kitchen alcove	Windows not required
Living rooms and dining rooms	10% of area served
Bedrooms and other finished rooms not mentioned above	5% of area served



Note: Further requirements for bedroom windows can be found in Article 9.7.2.2. of the Code

(9.7.2.3.)

Figure 9.1
Minimum Window Glass Areas

the requirement that results in the most glass area must be used.

Figure 9.1 illustrates requirements for minimum window areas in houses.

Bedroom Windows

Unless a door providing direct access to the exterior is on the same floor level as the bedroom, every floor level containing bedrooms must be provided with at least 1 outside window that can be opened from the inside without the use of tools. These are referred to as egress windows. The intention is that an emergency means of access or escape be provided on floors with bedrooms. These windows must have an unobstructed open portion having a minimum area of 0.35 m² (3.8 ft²) with no dimension less than 380 mm (15"). This required opening must be maintained without the need for additional support. For sliding windows, the minimum dimension must apply to the openable portion of the window.

Sills must be no more than 1 m (3' 3") above the floor for egress windows (see Figure 9.2), except for those of basements.

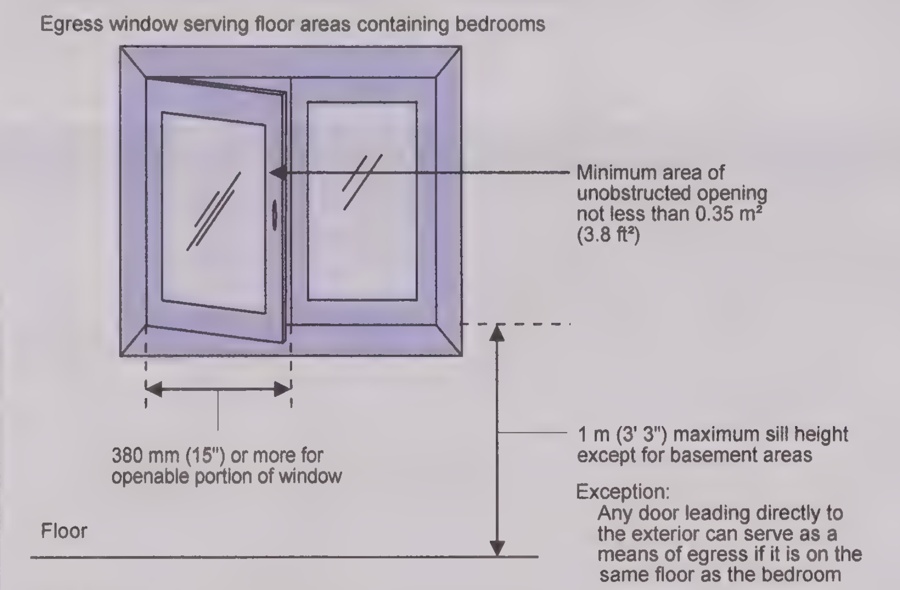


Figure 9.2
Egress Window Requirements (9.9.10.1.)

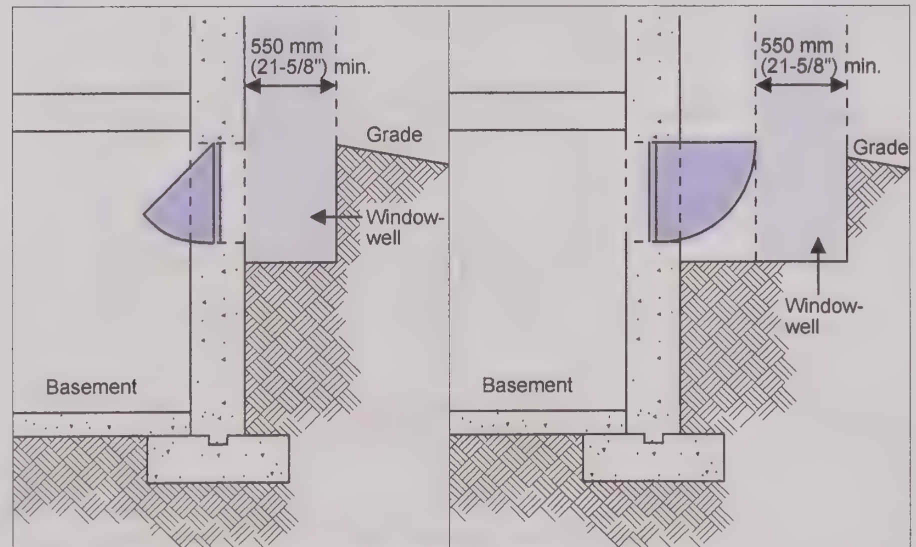


Figure 9.3
Egress Window Openings Into a Window Well (9.9.10.1.)

Windows Opening Into a Window Well

A clearance of at least 550 mm (21-5/8") must be provided in front of windows that open into a window well. For escape in emergencies, the sash of windows that swing towards the window well must not reduce the clearance. Any protective enclosure installed over the window well must be openable from the inside without the use of tools, keys or special knowledge of the opening mechanism. Figure 9.3 illustrates the requirements of this Code provision. Generally, the opening should not require the removal of the window to achieve the required opening as prescribed by the Code.

Termite Protection

Where termites are known to exist and where windows or other openings at or below grade contain wood elements, the bottom of the window wells or adjacent ground must be at least 150 mm (5-7/8") below the nearest wood unless the wood is pressure treated with a chemical toxin to termites. Chemicals that are used must conform to a number of standards referenced in the Code.

Resistance to Forced Entry

Windows, or any part of a window in a dwelling unit which is located within 2 m (6' 7") of adjacent ground level, must be resistant to forced entry and must conform to Clause 5.3.5 of AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights".

Although this requirement only applies to windows within 2 m (6' 7") of adjacent ground level, some house and site features, such as balconies or canopy roofs, allow for easy access to windows at higher elevations. Break-in-resistant windows could be considered for all vulnerable locations.

Caulking and Glazing

Leakage around the window frame has been found to be the single largest

cause of window air leakage. It is important that sealants and caulking be durable and compatible with the materials being sealed.

Windows are normally installed in an opening which is 25 mm (1") larger than the frame to allow the window to be correctly leveled and squared by the use of shims or wedges. The larger opening also accommodates the differential shrinkage between the wooden house frame and the exterior cladding, particularly where it consists of masonry or stone veneer.

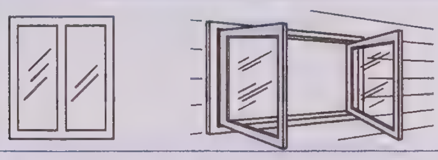
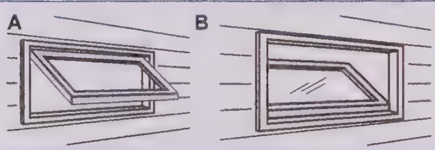
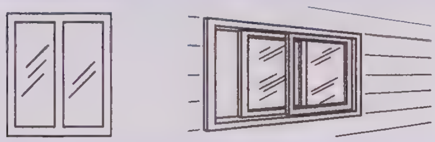
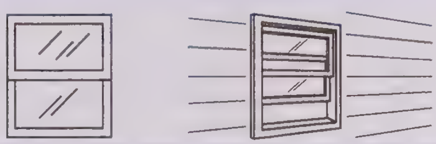
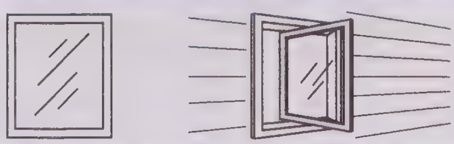
The insulation value provided in the shim space must be at least equivalent to that required for the wall. Caulking must be provided between window frames or trim and the exterior siding or masonry in conformance with the caulking requirements detailed in Chapter 15 in this Guide.

Air leakage through the window frame can be controlled by the use of durable, flexible gaskets to make an airtight seal between the glazing and sash, and to provide an airtight seal between operable sashes and the frame. Sealants used to seal the sash component to the glass component of a factory-sealed double-glazed unit must be compatible with the factory-installed glass edge sealant. In general, windows with compression rather than sliding seals provide greater air-tightness.

Control of Heat Gain and Heat Loss Through Windows

All windows and skylights separating heated space from unheated space or the exterior must be designed, constructed, and installed to both minimize condensation on the interior surface, and ensure comfortable conditions for the occupants. They are required to include a thermal break, and must have an overall coefficient of heat transfer not more than 2.0 W/(m^2•°C) or an energy rating (ER) of not less than 17 for operable windows and 27 for fixed windows. A basement window that incorporates a loadbearing structural frame is permitted to be double glazed with a low-E coating.

Window Types

Window type	Ventilation	Description
 Fixed	0%	• consists of a frame and glazed stationary sash • when used in conjunction with operable window units thickness of fixed sash should approximate cross-sectional dimensions of any adjacent operating units
 Casement	100%	• operating sash, usually swinging outward, part of operating sash may close on itself or on a vertical mullion • able to direct incoming ventilation
 A Awning B Hopper	100% 100%	• similar to casement windows but hinged at top (awning type) or bottom (hopper type) • may be stacked vertically with sash closing on itself or on meeting rails • able to direct incoming ventilation
 Sliding	50-66%	• may consist of 2 sashes of which one slides horizontally (50% ventilation) or 3 sashes of which the middle is fixed while the other 2 slide (66% ventilation)
 Double -hung	50%	• both window sashes move vertically, held in desired position by friction fit against the window frame or by various balancing devices • single-hung windows are similar with one sash fixed
 Pivoting	100%	• similar to casement window but a top and bottom pivot is used instead of side hinges • screening not possible

Note: These are optimal values, and may be less, depending on the particular design.

In electrically heated houses, the glazing must also meet the minimum energy ratings (ER) as specified by the Code (see Chapter 13). Energy ratings combine the performance of the glazing, the frame and the spacers to provide a basis for comparing the effect different windows can have on a house's heat loss. The ER considers the window's total heat loss and its solar gains. ER allows for the quick comparison of two similar windows to determine which is more energy efficient. The higher the energy rating the better the window from an energy performance viewpoint (e.g., a window with a ER +3 is better than one with ER -4). Unfortunately, it cannot be used to estimate the actual heat loss or heat gain through the window.

Supplementary Standard SB-12 contains additional information on the thermal performance of windows (refer to Chapter 13).

Looking Ahead

Chapter 5, Means of Egress and Chapter 6, Fire Safety and Sound Control identify further requirements for windows as they relate to fire and the movement of people.

Chapter 13, Energy Efficiency and Chapter 15, Exterior Finishes indicate the thermal resistance and caulking requirements for windows.

Window Size Checklist

The following 3 items govern the required unobstructed glass area for a window in a dwelling unit. Be sure to consult each associated Code Article to ensure proper sizing of windows.

- ☐ Egress (9.9.10.1.)
- ☐ Natural ventilation (9.32.2.1.)
- ☐ Natural light (9.7.2.3.)

Skylights

Skylights permit natural lighting of spaces from above, and include units skylights, roof windows, and tubular daylighting devices. Skylight curbs are required to prevent snow and rain from penetrating to the interior of the building. Care in detailing flashing is important to prevent water leaks.

Movement of air near skylights can help to control condensation. This is particularly true in rooms where high humidity is prevalent. Forced air heating registers are often recommended in the vicinity of the skylight.

NATURAL VENTILATION

BUILDING CODE REFERENCES

DIVISION B
9.32.2.1. Natural Ventilation Area
9.32.2.2. Protection from Weather and Insects

Rooms that are intended to be ventilated naturally must be provided with an unobstructed opening that can be opened to the outdoors. The ventilation area frequently takes the form of windows. Ventilation requirements are shown in Figure 9.4.

Natural Ventilation Area

Location	Minimum Unobstructed Area
Bathrooms or water closet rooms	0.09 m² (0.97 ft²)
Unfinished basement space	0.2 per cent of the floor area
Dining rooms, living rooms, bedrooms, kitchens, combined rooms, dens, recreation rooms or all other finished rooms	0.28 m² (3 ft²) per room

Note:
If a vestibule opens directly off a living or dining room, ventilation to the outdoors for these rooms may be through the vestibule.

Figure 9.4
Ventilation Requirements (9.32.2.1.)

Window Performance

The principal ways in which heat is lost through a window assembly are:

(a) Through the glazing by conduction, convection and radiation;
(b) Through the edge of the glazing, and through the window frame by conduction;
(c) By air leakage through the window at the sash and at junctions between sliding elements; and
(d) By air leakage around the window frame.

The first three sources of heat loss can be reduced by selecting an appropriate window. The last can be reduced through proper installation.

Increasing the number of still air spaces, by using triple glazing for instance, will reduce conduction losses. Incorporating a thin metallic, low-emissivity coating over the glazing will also improve the heat loss performance of windows. It should however be noted that in most cases, low emissivity films will also improve the heat transmission from radiation.

Filling the sealed glazing units with a low density gas such as argon can further improve the heat loss performance of the window.

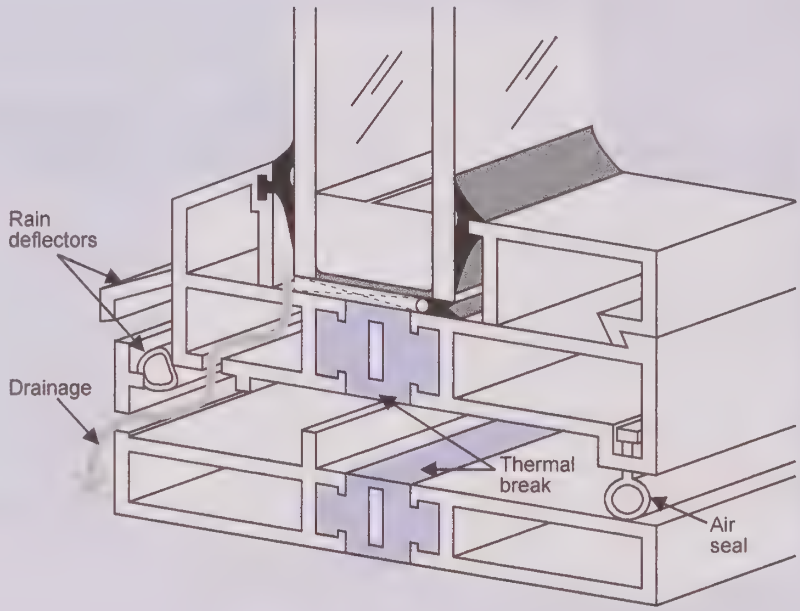
Thermal bridging at the window sash and frame often contribute to a cooling of the edges of the glazing. During cold periods, condensation may appear around the edge of the glazing.

Continual wetting, dripping or constant full window condensation may cause material degradation problems.

In these cases, in addition to investigating the quality of the window that has been installed, it is important to identify other possible underlying causes of the condensation problem. These causes might include, high interior relative humidity, cool interior temperature or poor air circulation at the window surface (sometimes caused by heavy draperies).

Identifying the cause of excessive window condensation is the first step toward developing a solution.

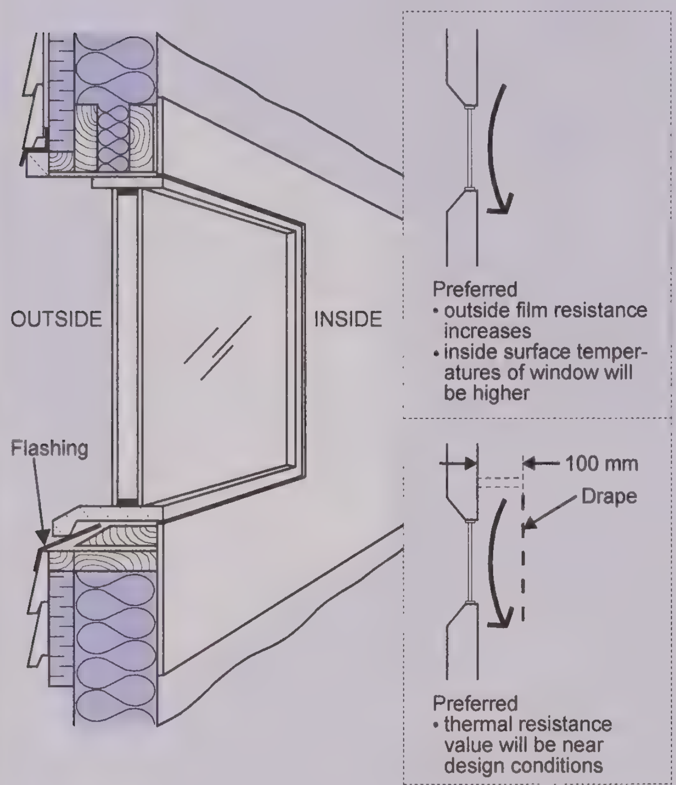
Heat loss by conduction through the window frame can be reduced by using a low conductivity material such as wood or PVC for the frame and/or either by ensuring that metal window frames incorporate an effective thermal break. See the illustration below.



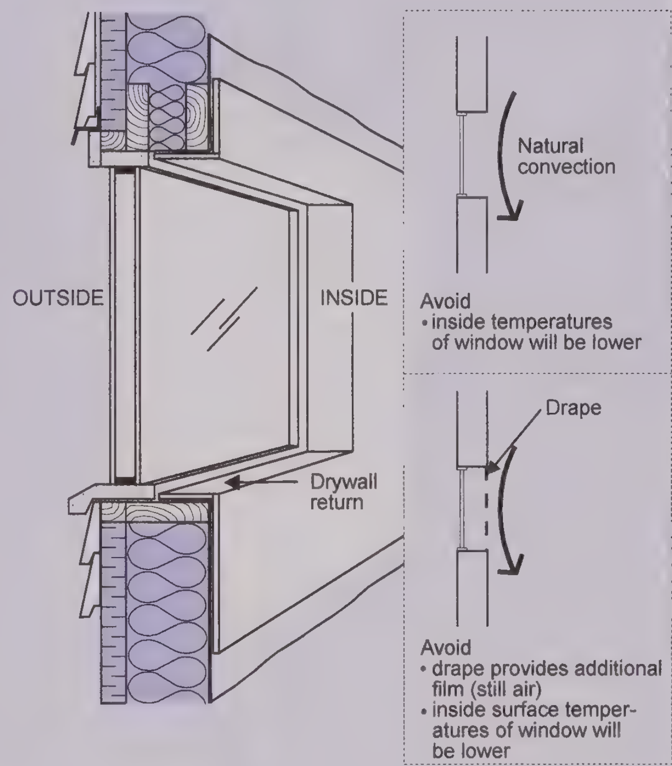
Secondly, condensation on the inside surface of the glass is reduced as the window is in the warmer part of the wall, and, air flow over the surface is improved. See the illustration below.

Heat loss also occurs where spacers are in contact with each layer of glazing. Using insulating spacers and seals such as plastic, silicone, or glass fibre as opposed to aluminum will reduce heatloss and help to eliminate condensation and cracking around the edge of the glazing.

Preferred: Window Mounted on Inside of Rough Stud Opening



Avoid: Window Mounted on Outside of Rough Stud Opening



10 FIREPLACES, CHIMNEYS, AND FLUES

This Chapter reviews the design and construction of solid fuel-burning fireplaces and chimneys. The requirements of non-solid fuel-burning appliances are governed by other regulatory bodies and are beyond the scope of this Guide and the Building Code.

Fireplaces and chimneys are commonly constructed of masonry or concrete. Section 9.20. and Subsection 9.3.1. outline the Code requirements for masonry and concrete materials that may be used.

The need for proper design, installation, ventilation and operation of fireplaces, chimneys, and flues cannot be over-emphasized. Occupant health and safety can be compromised by improperly designed or installed solid fuel-burning appliances in the home. Prefabricated chimneys and fireplaces are discussed in some detail on the pages that follow. It is strongly recommended that manufacturers' specifications and other building standards are referenced for specific installation requirements where appropriate.

KEY POINTS

Fireplaces must be designed and constructed to fulfill the following functions:

- transfer structural loads to the surrounding soil or foundation wall;
- ensure fire safety by providing adequate clearances from combustible materials;
- provide adequate outside air to assist in the combustion process; and
- exhaust the by-products from the combustion of fuels.

FIREPLACES

BUILDING CODE REFERENCES

DIVISION B

9.22.1.1.	Application
9.22.1.2.	Masonry and Concrete
9.22.1.3.	Footings
9.22.1.4.	Combustion Air
9.22.2.1.	Brick or Steel Liners
9.22.2.2.	Firebrick Liners
9.22.2.3.	Steel Liners
9.22.3.1.	Thickness of Walls
9.22.5.1.	Hearth Extension
9.22.5.2.	Support of Hearth
9.22.6.1.	Required Damper and Size
9.22.7.1.	Slope of Smoke Chamber
9.22.7.2.	Wall Thickness
9.22.8.1.	Conformance to Standard
9.22.9.1.	Clearance to the Fireplace Opening
9.22.9.2.	Metal Exposed to the Interior
9.22.9.3.	Clearance to Combustible Framing
9.22.9.4.	Heat Circulating Duct Openings
9.22.10.1.	Appliance Standard
9.22.10.2.	Installation

A fireplace must provide for the proper combustion of fuel and the exhausting of combustion by products (smoke) in a safe manner. The installation, maintenance and inspection of solid fuel-burning systems must be carefully considered. It is recommended that WETT (Wood Energy Technical Training) certified individuals be consulted to ensure safe and effective installation of solid fuel-burning systems. Please see www.wettinc.ca for more information.

General Requirements

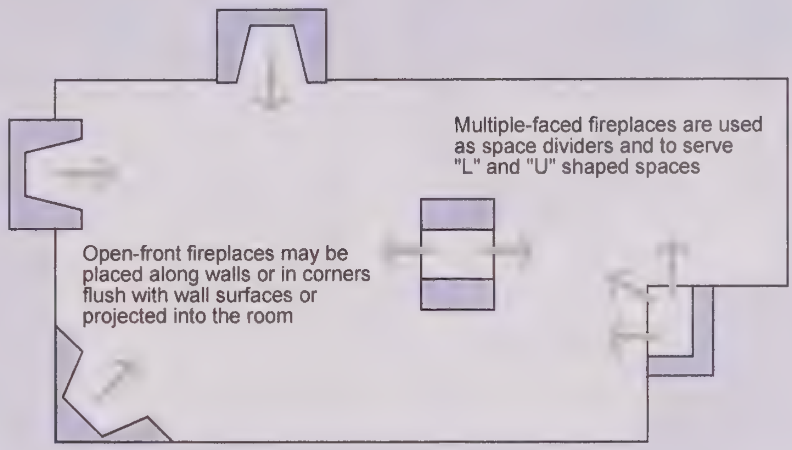
Footings must be provided under all masonry or concrete fireplaces and must rest on undisturbed soil, rock, or compacted granular fill. The size of the footing will be determined by the size of the fireplace, whether or not the chimney is supported, whether the fireplace provides support to structural elements of the building, and the bearing capacity of the soil. A footing is required to be at least 100 mm (4") thick and its projection must not be greater than the thickness unless it is reinforced. Chapter 2, Foundations, provides more details.

Fireplace Location and Selection

Factors that influence the selection and design and placement of fireplaces are numerous. The traffic flows through a space need to be examined to determine the appropriate location for the fireplace.

In addition to aesthetic considerations, fireplace selection must consider the maximum amount of heat that can be supplied to a space by a fireplace to maintain a comfortable temperature.

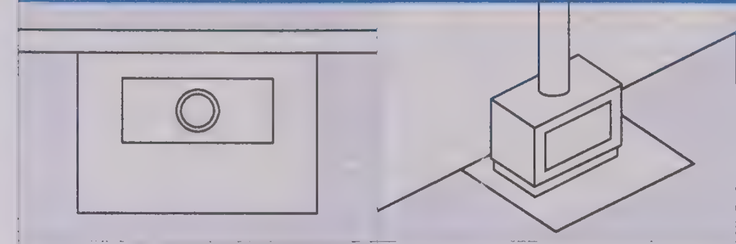
The figure below presents fireplace selection and location issues.



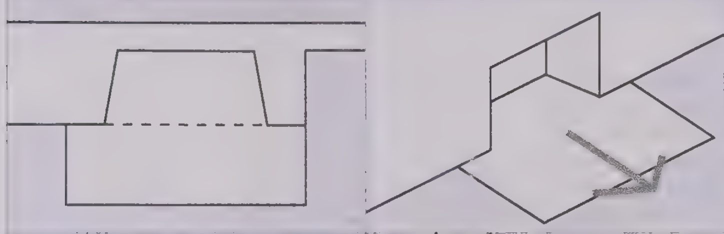
Looking Back

See Chapter 2, Foundations for footing requirements.

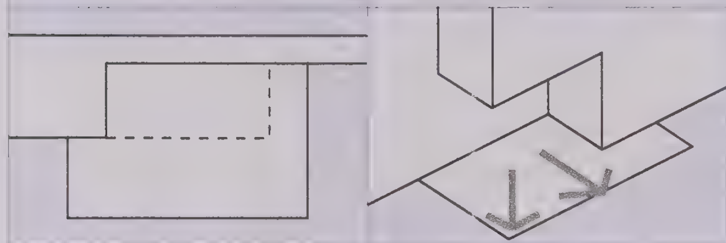
Fireplace Types



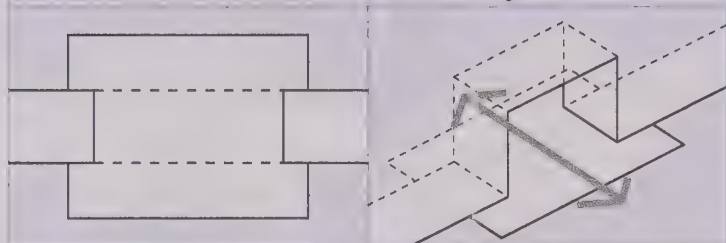
FREESTANDING
Prefabricated, self-contained units in various designs, should be set on an noncombustible base. Exposed flue (metal-lined or insulated) either rises through ceiling or runs through wall to the exterior.



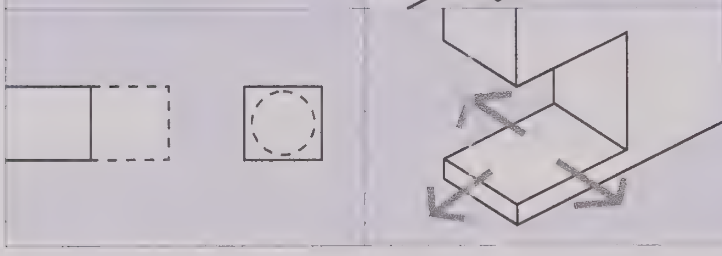
OPEN FRONT
The most common type of fireplace. Made from masonry or prefabricated metal and directional (frontal) in form.



OPEN FRONT AND SIDE
The open corner may be cantilevered or post-supported. Bi-directional with primary visual direction along the diagonal, with a secondary one perpendicular to the long face.



OPEN FRONT AND BACK
It is located within a space-dividing element with frontal direction toward two spaces.



OPEN THREE SIDES AND ALL SIDES
The open corners may be cantilevered or post-supported. Metal fireplace hoods and flues may be suspended from above. Visually multi-directional or omnidirectional depending on its form and proportions.

Fireplace Operation

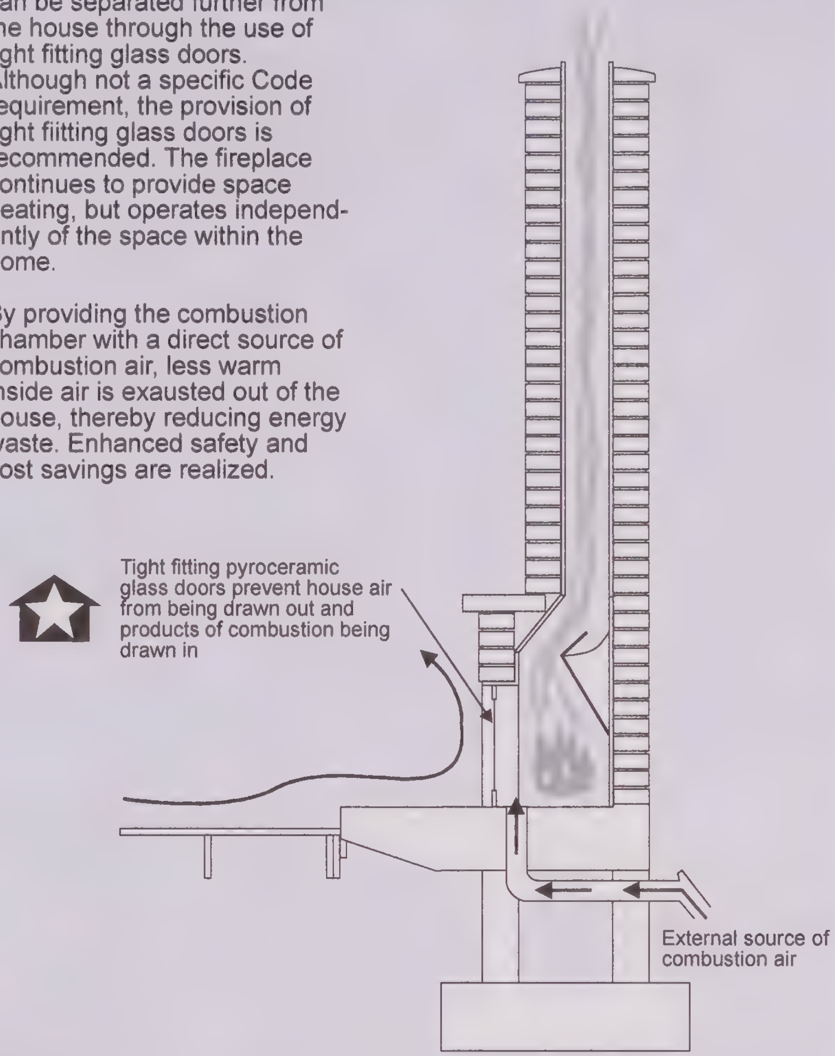
Most solid fuel-burning fireplaces burn wood as a fuel.

For proper operation, any fireplace must be provided with an adequate supply of air and have the ability to exhaust a variety of combustion by-products. Every solid fuel-burning fireplace must have a supply of combustion air from outside. The air intake should be located as close as possible to the opening of the fireplace. There are several reasons for this requirement. By providing the fireplace with an external source of combustion air the competition for inside air is reduced and therefore the potential for backdrafting of the by-products of combustion is minimized.

A clothes dryer, for example, exhausts air from the home creating a pressure difference that could cause air to be drawn into the house from any available source, such as a fireplace chimney. The tendency towards tightening of the building envelope can further increase the backdrafting potential.

The operation of the fireplace can be separated further from the house through the use of tight fitting glass doors. Although not a specific Code requirement, the provision of tight fiitting glass doors is recommended. The fireplace continues to provide space heating, but operates independently of the space within the home.

By providing the combustion chamber with a direct source of combustion air, less warm inside air is exausted out of the house, thereby reducing energy waste. Enhanced safety and cost savings are realized.



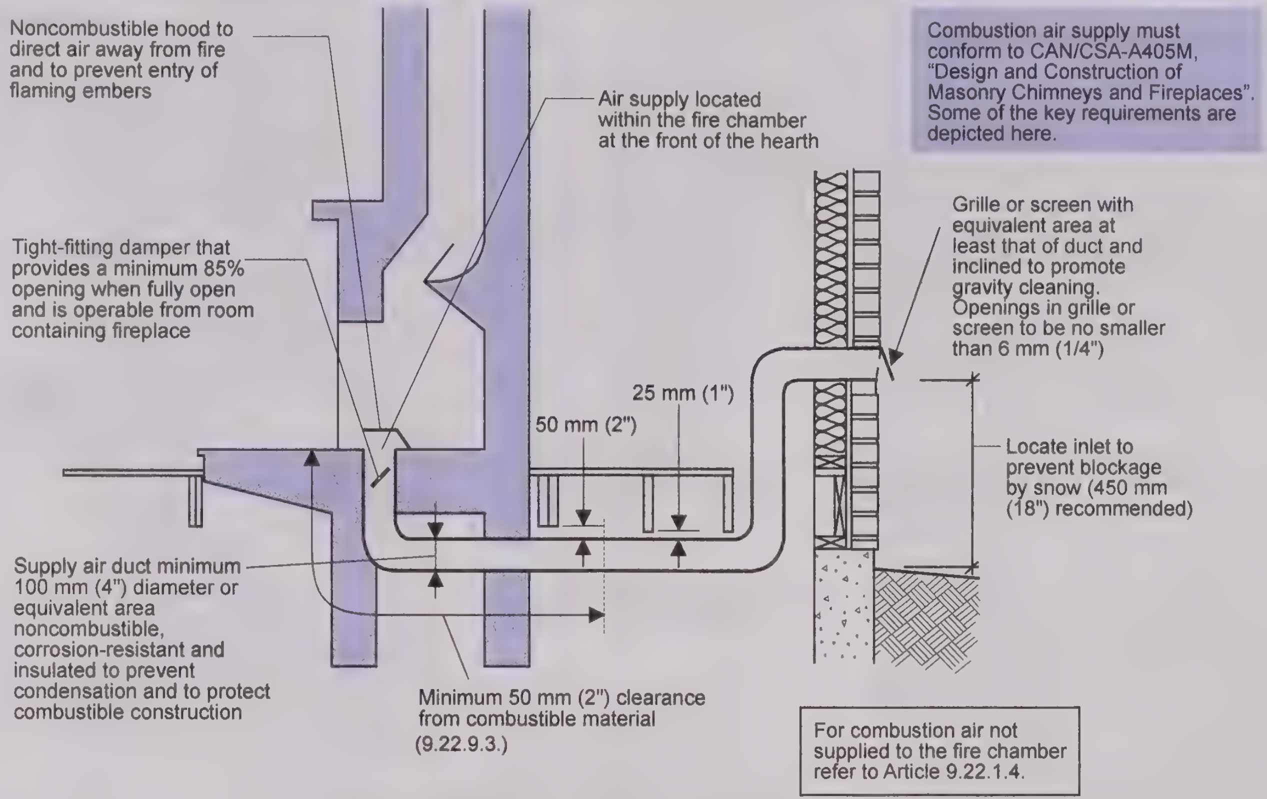


Figure 10.1
Air Intake Requirements for Combustion Air Supplied to Fire Chamber (9.22.1.4.)

Combustion Air for Fireplaces

All solid fuel-burning fireplaces, including factory-built fireplaces, must be provided with an outside air source for the combustion of fuel. The combustion air must be supplied by a noncombustible, corrosion-resistant supply duct with a minimum 100 mm (4") diameter. The supply duct must be equipped with a tight-fitting damper located close to the interior outlet and must be operable from the room containing the fireplace with an operating mechanism that indicates the actual position for the damper. The interior outlet of the combustion air duct must be located as close as possible to the opening in the face of the fireplace and must be designed to prevent embers from entering the supply duct. The exterior intake should prevent the entry of precipitation, animals and insects.

Where a supply of combustion air is provided directly to the fire chamber of a fireplace, including a factory-built fireplace or a steel fireplace liner, the installation must comply with the "Outdoor Air Supply" requirements provided in CAN/CSA-A405M, "Design and Construction of Masonry Chimneys and Fireplaces". See Figure 10.1.

Factory-built fireplaces are also required to have external combustion air and must be installed according to Subsection 9.22.8. of the Code and discussed later in this Chapter. Provisions for fireplace inserts found in Subsection 9.22.10. of the Code are also outlined.

Clearance of Masonry Fireplaces to Combustibles

The clearance of a fireplace to combustible framing must conform to Figure 10.2. Interior wall framing must have 100 mm (4") of clearance from the back and sides of the fireplace while exterior wall framing must have at least 50 mm (2") clearance from the back and sides. The clearance from the smoke chamber to interior wall framing can be no less than 50 mm (2") and 25 mm (1") to exterior wall framing.

It is very important that combustible material is kept at a safe distance from the opening of a fireplace. Figure 10.3 illustrates the required clearances. Combustible materials must not be placed within 150 mm (5-7/8") of the fireplace opening or heat circulating vent. If the combustible material projects more than 38 mm (1-1/2") from the face of the fireplace, the clearance of the combustible material must be doubled to 300 mm (11-3/4") from the fireplace opening or from the heat circulating vent. Combustible material requires at least 50 mm (2") of clearance from metal that penetrates from inside out to the face of the fireplace such as a damper control.

Fireplace Liners

A fireplace must have at least 50 mm (2") thick firebrick around the sides and the back and at least 25 mm (1") on the floor. Firebricks are required to be laid with high temperature cement mortar that complies with CAN/CGSB 10.3, "Air Setting Refractory Mortar." The joints between firebricks must be offset from the surrounding masonry in the fireplace.

Fireplaces can also be lined with steel, provided that manufacturing and installation complies with CAN/ULC-S639, "Steel Liner Assemblies for Solid-Fuel Burning Masonry Fireplaces."

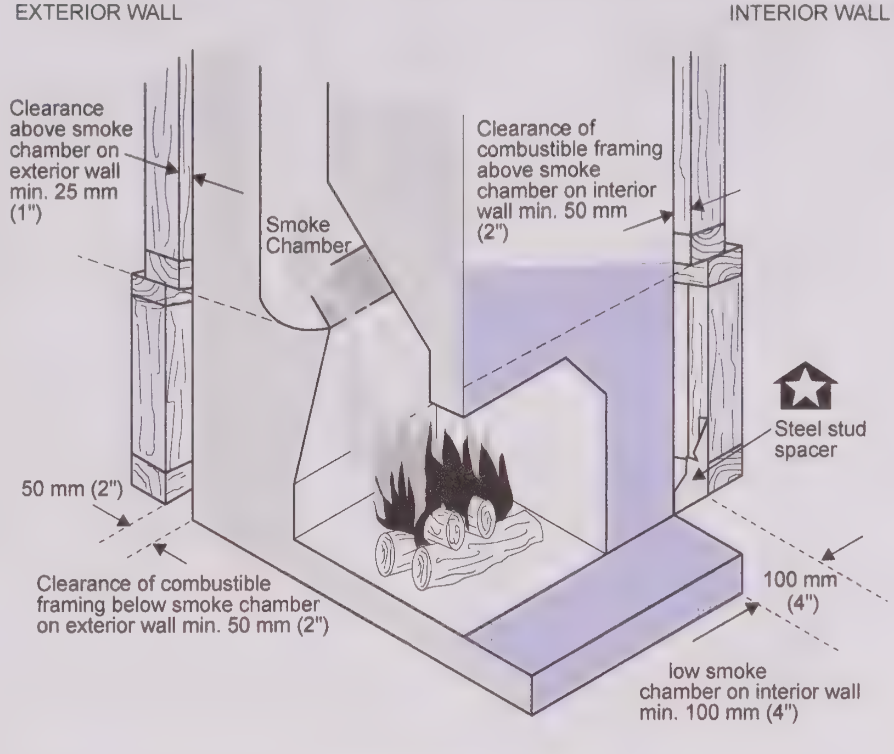


Figure 10.2
Clearance of a Fireplace to Combustible Framing (9.22.9.3.)

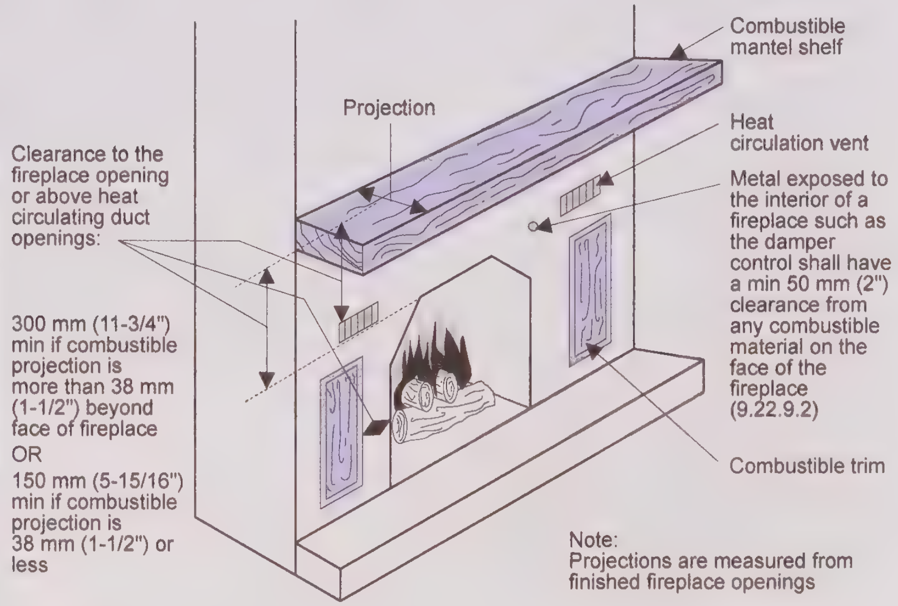
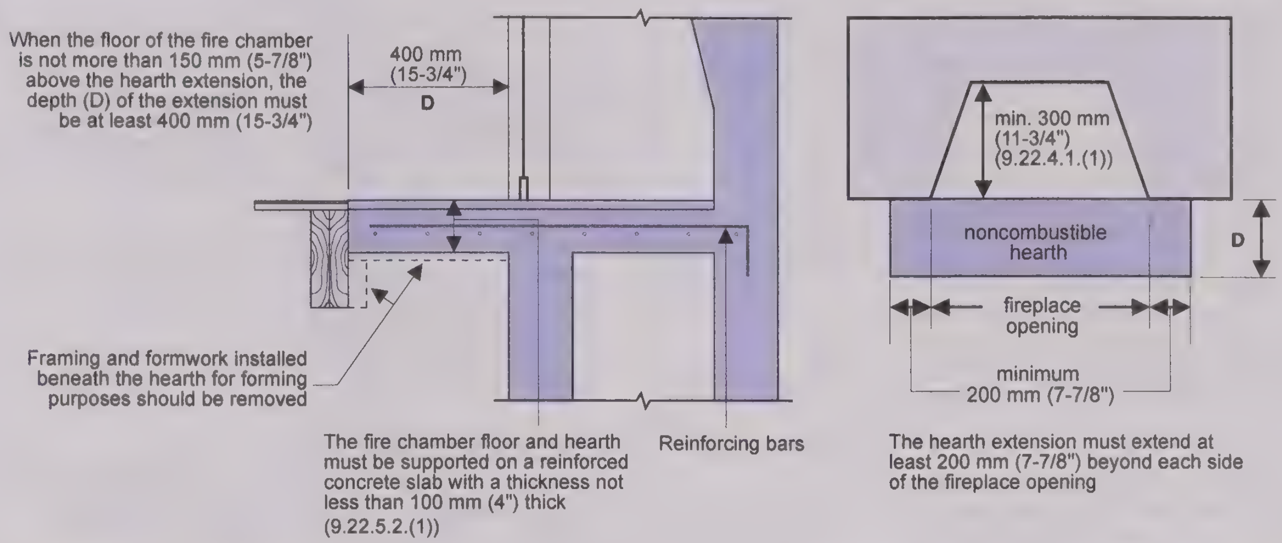


Figure 10.3
Clearance of Combustible Material from Fireplace Opening (9.22.9.1.) (9.22.9.4.)



Maximum Fire Chamber Elevation (H) Above Hearth Extension, mm (in)	Minimum Depth (D) of Hearth Extension, mm (in)
150 (5-7/8)	400 (15-3/4)
300 (11-3/4)	450 (17-3/4)
350 (13-3/4)	475 (18-3/4)
400 (15-3/4)	500 (19-3/4)
450 (17-3/4)	525 (20-3/4)

From CAN/CSA-A405 "Design and Construction of Masonry Chimneys and Fireplaces"

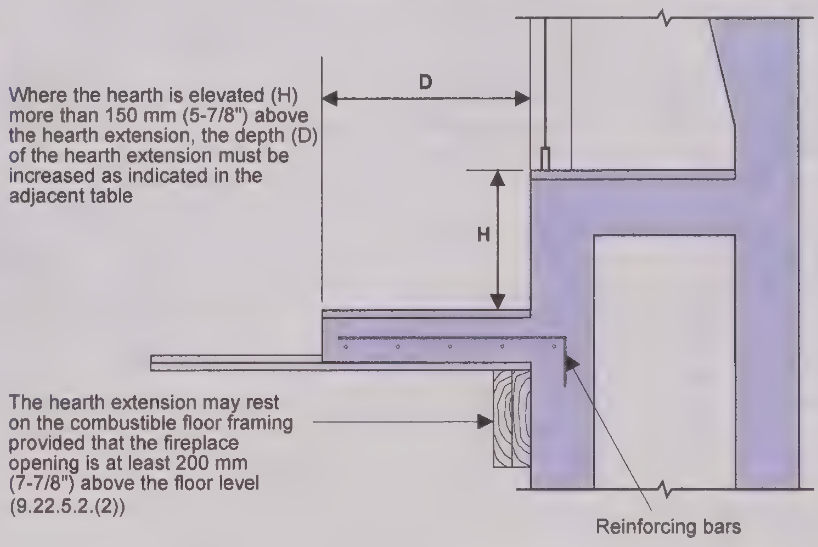


Figure 10.4
Hearth Dimension and Support

(9.22.5.2.)

Masonry and Concrete Hearths

Where the floor of the fire chamber is not more than 150 mm (5-7/8") above the hearth extension, a fireplace must have its hearth extend out beyond the face of the fireplace at least 400 mm (15-3/4") horizontally and 200 mm (7-7/8") to either side. The extension of the hearth must be noncombustible. Refer to Figure 10.4.

If the floor of the fire chamber is more than 150 mm (5-7/8") but not more than 300 mm (11-3/4") above the hearth extension, the hearth must extend an additional 50 mm (2") out from the face of the fireplace. If the fire chamber floor is more than 300 mm (11-3/4") above the hearth extension, this extension must be increased again by an additional 25 mm (1") for each additional 50 mm (2") in elevation above 300 mm (11-3/4"). Refer to Figure 10.5.

The fire chamber and hearth extension must be supported on a reinforced concrete slab not less than 100 mm (4") thick at its supports and, if cantilevered, not less than 50 mm (2") at its unsupported edge.

A hearth extension for a fireplace with an opening raised not less than 200 mm (7-7/8") above a combustible floor level can be supported on that floor with certain conditions detailed in CAN/CSA-A405M, "Design and Construction of Masonry Chimneys and Fireplaces." Refer to Figure 10.4.

Better Building Note

If you're installing a fireplace, consider how the floor finish (e.g. hardwood) may react when exposed to heat from the fireplace.

A fireplace that has a liner requires that the back and sides of the wall, including the thickness of the liner, be at least 190 mm (7-1/2") thick where the firebrick or metal liner is less than 51 mm (2") thick. When a steel fireplace liner is used with an air circulating chamber surrounding the fire chamber, the back and sides of the fireplace can be constructed of solid masonry units not less than 90 mm (3-1/2") thick or hollow masonry units not less than 190 mm (7-1/2") thick. Refer to Figure 10.5. The minimum thickness of a fireplace liner is 50 mm (2") for the sides and back and 25 mm (1") for the floor.

The masonry over a fireplace opening must be supported with a steel lintel, or built with a masonry arch that conforms to Article 9.20.5.2., or be constructed with reinforced concrete.

A metal damper must be installed above the fireplace in the base of the smoke chamber. The damper must be adequately sized to cover the full area of the throat opening.

The smoke chamber located above the fireplace requires the same minimum thickness of masonry as the fireplace. The sides and back must be at least 190 mm (7-1/2") thick. If the back wall is adjacent to the exterior its thickness can be 140 mm (5-1/2"). The smoke chamber slopes inward to concentrate the path of rising smoke up through the flue. This slope must be no greater than 45° to the horizontal as shown in Figure 10.6.

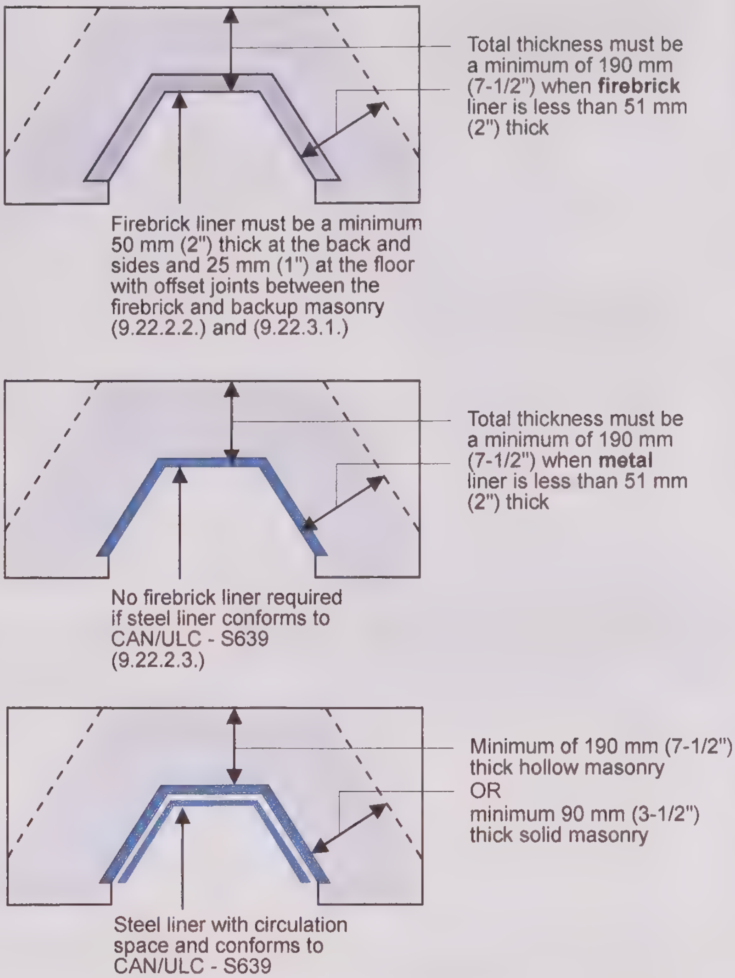


Figure 10.5
Fireplace Liner
(9.22.3.1.)

Factory-Built Fireplaces

The installation of factory-built fireplaces must comply with CAN/ULC-S610, "Factory-Built Fireplaces." Some general requirements include: all prefabricated fireplaces must have prefabricated chimneys which are specifically tested for use with the fireplace; installation instructions provided by the manufacturer must accompany the fireplace; all parts and components must be made of noncombustible material; only factory supplied hardware is to be used for installation; and on-site cutting and make-fitting is strictly prohibited.

Other provisions include requirements for unit assembly, joints, fire block spacers, supports, radiation shields, flue dampers, caps, roof assemblies, fire screens, hearth assembly, combustion air, and doors. A prefabricated fireplace does not necessarily have to be enclosed in masonry. Tile or gypsum finishes may also be used.

If a factory-built fireplace is installed in the basement ensure it is certified for this type of installation.

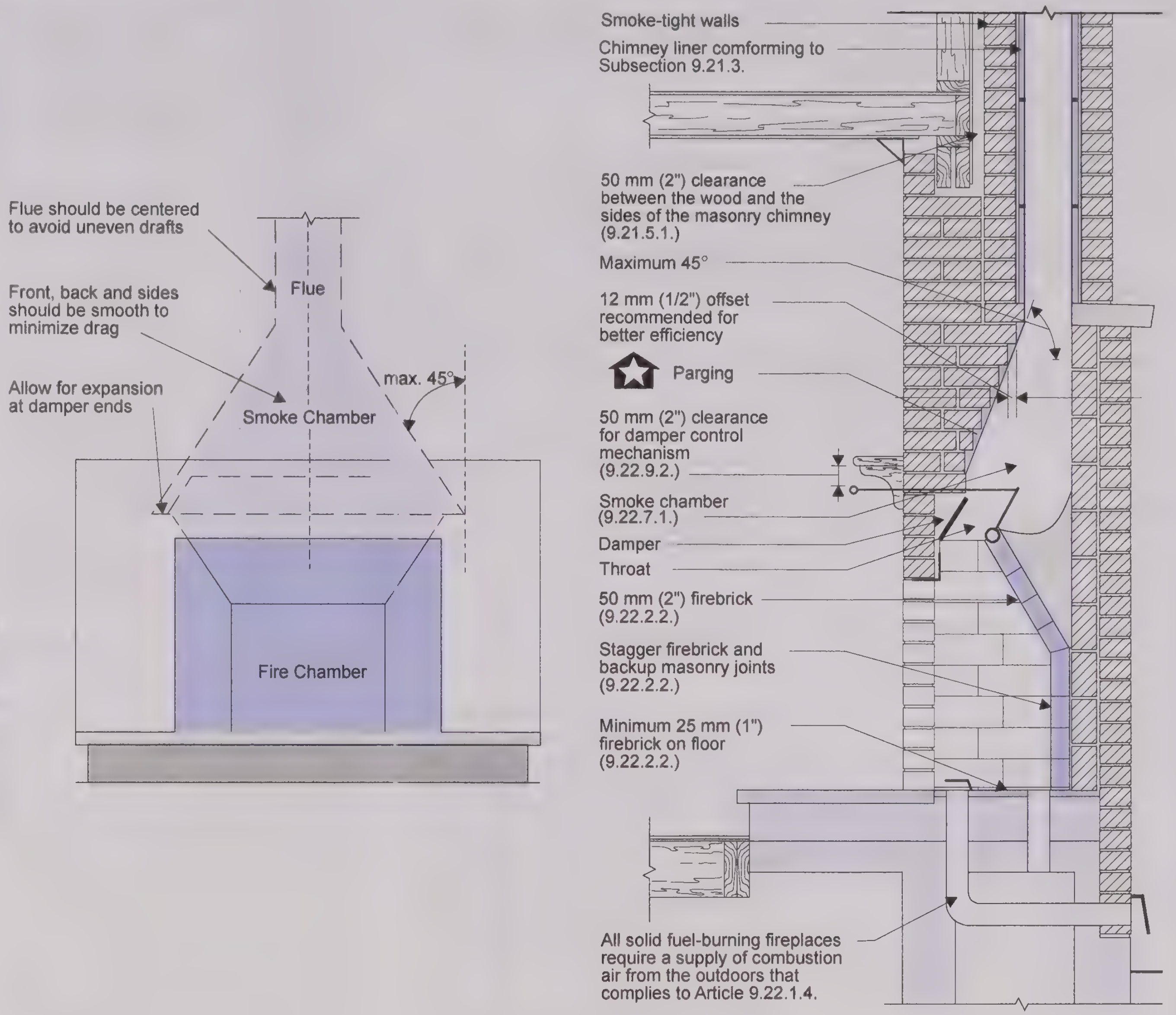


Figure 10.6
Slope of Smoke Chamber

(9.22.7.1.)

Fireplace Inserts

Fireplace inserts are required to be installed in conformance with CAN/CSA-B365, "Installation Code for Solid Fuel Burning Appliances and Equipment" by Article 9.22.10.2. A fireplace insert may only be installed in a fireplace that has at least 190 mm (7-1/2") of solid masonry between the smoke chamber and any combustible materials unless the insert is designed and listed for lower clearances.

Provide a factory-built chimney liner from the throat of the insert to the top of the chimney or completely seal the connection between the chimney flue and insert. Refer to Figure 10.7 for other details.

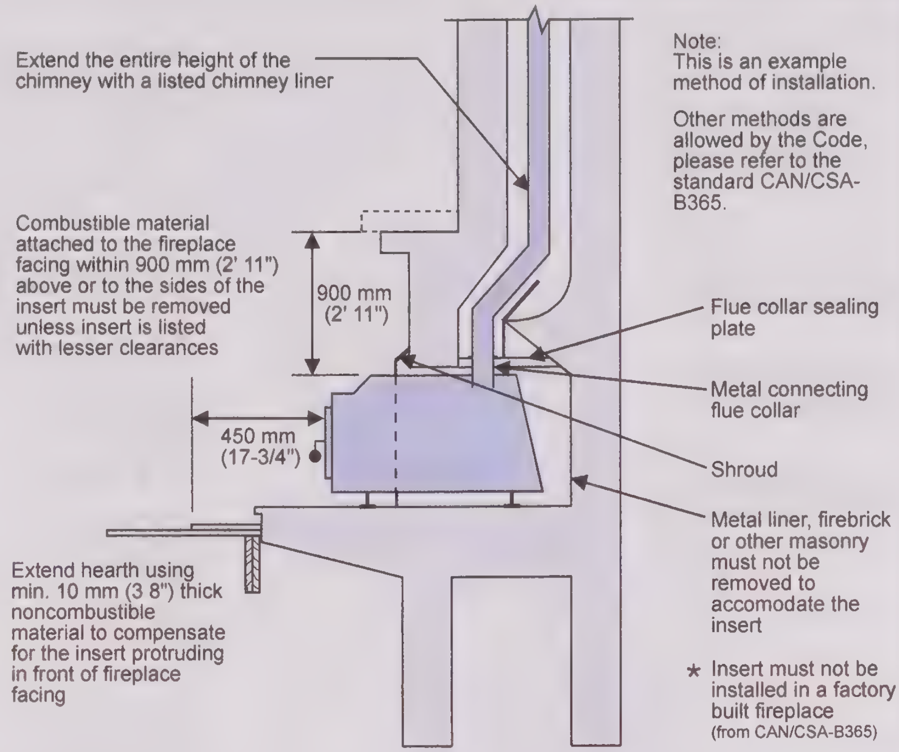


Figure 10.7
Fireplace Inserts (9.22.10.1.)

CHIMNEYS AND FLUES

BUILDING CODE REFERENCES

DIVISION B

6.3.1.2.	Masonry or Concrete Chimneys
6.3.1.3.	Metal Smoke Stacks
9.1.1.5.	Proximity to Existing Above Ground Electrical Conductors
9.21.1.1.	Application
9.21.1.2.	Factory-Built Chimneys
9.21.1.3.	Flue Pipes
9.21.1.4.	Chimney or Flue Pipe Walls
9.21.2.1.	Chimney Flue Limitation
9.21.2.2.	Connections of More Than One Appliance
9.21.2.3.	Inclined Chimney Flues
9.21.2.4.	Size of Chimney Flues
9.21.2.5.	Fireplace Chimneys
9.21.2.6.	Oval Chimney Flues
9.21.3.1.	Lining Materials
9.21.3.2.	Joints in Chimney Liners
9.21.3.3.	Clay Liners
9.21.3.4.	Firebrick Liners
9.21.3.5.	Concrete Liners
9.21.3.6.	Metal Liners
9.21.3.7.	Installation of Chimney Liners
9.21.3.8.	Spaces between Liners and Surrounding Masonry
9.21.3.9.	Mortar for Chimney Liners
9.21.3.10.	Extension of Chimney Liners
9.21.4.1.	Unit Masonry
9.21.4.2.	Concrete
9.21.4.3.	Footings
9.21.4.4.	Height of Chimney Flues
9.21.4.5.	Lateral Stability
9.21.4.6.	Chimney Caps
9.21.4.7.	Cleanout
9.21.4.8.	Wall Thickness
9.21.4.9.	Separation of Flue Liners
9.21.4.10.	Flashing
9.21.5.1.	Clearance from Combustible Materials
9.21.5.2.	Sealing of Spaces
9.21.5.3.	Support of Joists or Beams

Chimneys are used to exhaust the by-products from the combustion of a fuel such as oil, gas, or wood. The chimney, by definition is the entire structure provided to allow the exhaust of unwanted fumes or smoke. The liner is the inner surface of a chimney exposed to the exhausted by-products. The passage through which these fumes or smoke travel is referred to as the flue.

The requirements for fire safety and health that follow must be strictly adhered to. The requirements for the exhaust of smoke from fireplaces as well as other appliances within the scope of the Guide are detailed in this section. Chapter 11 Mechanical Systems of this Guide identifies other appliances that require chimneys.

Gas and oil-fired appliances must be designed and installed according to specific applicable standards. Local gas utilities can provide more information.

General Requirements

The requirements of Part 9 of the Code are limited to chimneys that are no greater than 12 m (39' 4") in height, constructed of masonry or concrete, and that serve fireplaces or appliances having a total combined output of 120 kW (410,000 BTU/h) or less. The installation of flue pipes for appliances such as stoves, cooktops, prefabricated fireplaces, and space heaters are governed by CAN/CSA-B365, "Installation Code for Solid-Fuel Burning Appliances and Equipment". As noted earlier, all prefabricated fireplaces require factory-built chimneys. The installation of these chimneys is regulated by CAN/ULC-S629, "650 °C Factory-Built Chimneys". Additional chimney requirements are found in the corresponding section of the Code.

A flue must be constructed completely air-tight so as to prevent any smoke, burning embers, or flames from escaping and creating a fire hazard.

Clearance of Chimneys and Flues to Combustibles

Clean out openings for fireplaces require a minimum clearance of 150 mm (5-7/8") from combustible material.

Clearance of combustible materials from chimneys is required as shown in Figure 10.8. A minimum of 50 mm (2") of clearance is required for interior chimneys and 12 mm (1/2") clearance for exterior chimneys.

Combustible flooring, subflooring and ceiling finish materials require a minimum clearance of at least 12 mm (1/2") from masonry or concrete chimneys as shown in Figure 10.9. All spaces created from these clearances must be sealed at the top or bottom as shown in Figure 10.9 with a noncombustible material. This seal must be air-tight to prevent the passage of smoke. Sheet metal is a suitable material for this purpose.

Joists and beams can be supported by masonry walls that enclose chimneys if combustible framing is separated by at least 290 mm (11-1/2") of solid masonry. Figure 10.10 summarizes the requirements of fireplaces and chimneys for minimum clearances from combustible construction.

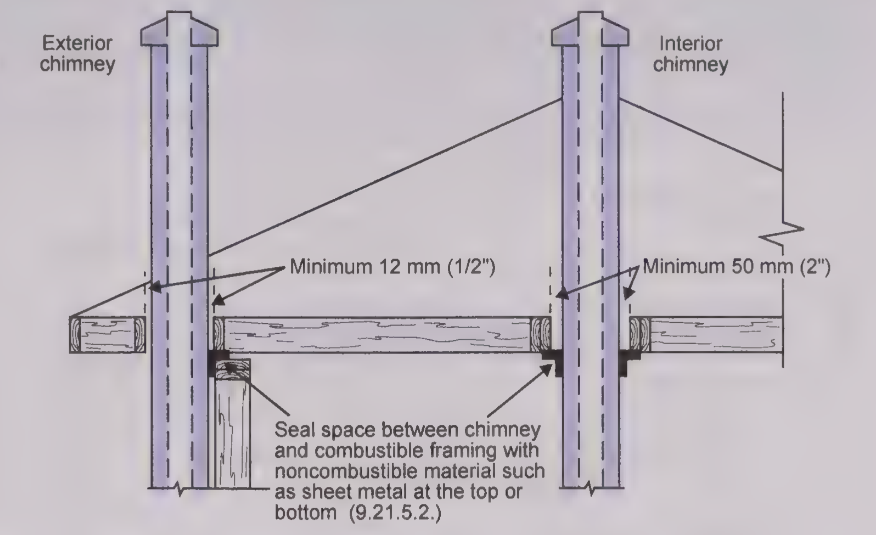


Figure 10.8
Clearance from Combustible Materials (9.21.5.1.)

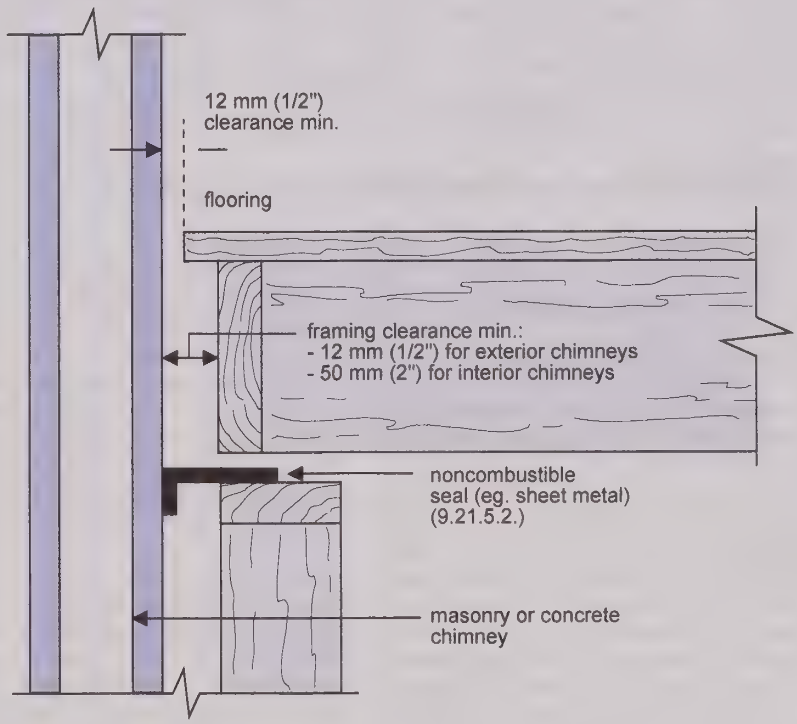


Figure 10.9
Clearances from Combustible Materials and Sealing Around Chimneys (9.21.5.1.(3))

Fireplaces and Chimneys: Clearance from Combustible Construction

	Component	Minimum Clearance from Combustible Materials
CHIMNEYS	Masonry or Concrete Chimneys	▪ 50 mm (2") for interior ▪ 12 mm (1/2") for exterior ▪ 12 mm (1/2") from combustible flooring, subflooring and ceiling finishes
CHIMNEYS	Cleanout Opening	▪ 150 mm (5-7/8")
CHIMNEYS	Chimney Flue	▪ 290 mm (11-1/2") of solid masonry from joists and beams if supported by the masonry walls enclosing the flue
CHIMNEYS	All spaces between chimneys and combustible material must be sealed with noncombustible material	
FIREPLACES	Fireplace Opening or Heat Circulating Duct Opening	▪ 150 mm (5-7/8") ▪ 300 mm (11-3/4") if combustible material projects more than 38 mm (1-1/2") out from the face of the fireplace
FIREPLACES	Back and Sides of a Solid Fuel-Burning Fireplace	▪ 100 mm (4") for an interior wall ▪ 50 mm (2") for an exterior wall
FIREPLACES	Back and Sides of the Smoke Chamber of a Solid Fuel-Burning Fireplace	▪ 50 mm (2") for an interior wall ▪ 25 mm (1") for an exterior wall

Figure 10.10
Summary of Clearance from Combustible Construction Requirements

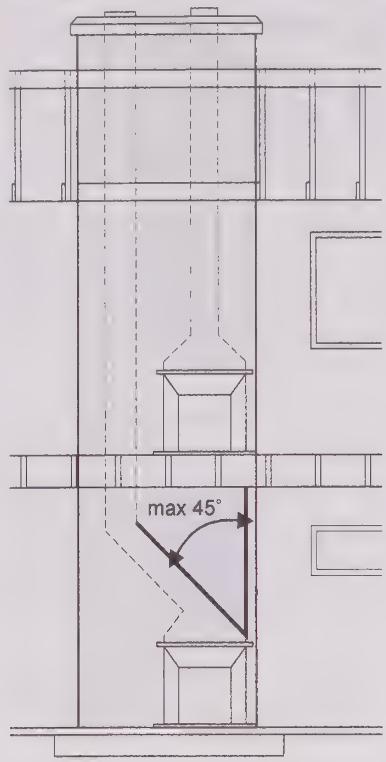


Figure 10.11
Inclination of Chimney Flues (9.21.2.3.)

Limitations for Chimney Flues

Chimneys serving fireplaces cannot serve any other appliance. More than one appliance may be connected to a chimney flue which has been designed to provide adequate draft provided all the appliances are located on the same floor. The connection of a solid fuel-burning appliance must be located below any connections serving appliances that burn other types of fuel. Solid fuel- burning appliances must not be connected to a flue that serves a natural-gas or propane-fired appliance. It must also not be connected to a flue that serves an oil-burning appliance unless listed in the installation requirements and both of the appliances meet the installation requirements.

A chimney must not be inclined more than 45° to the vertical. See Figure 10.11.

The size of a chimney flue for a fireplace must conform to the tables in Figure 10.12 and 10.13. A chimney flue may be oval in section provided that the required cross-sectional area is equivalent to the required area. The width of an oval flue must not be less than 2/3 its breadth. The requirements for chimney flue heights are discussed later on in Figure 10.17.

Flues serving any other appliances must conform to Section 1.5, or to CAN/CSA-B365 "Installation Code for Solid-Fuel Burning Appliances and Equipment". A chimney flue is required to be at least equal in cross-sectional area to that of the flue pipe from the appliance which is connected to it. The standard identifies examples of methods for passing a flue pipe through a combustible assembly. Excerpts from the standard can be found at the end of this chapter, however it is important to consult the standard for the full details.

Diameter of Round Flues for Fireplace Chimneys

Fireplace Opening m² (ft²)	Chimney Height m, (ft-in) 3.0 to 4.5 (9' 10" to 15')		>4.5 to 5.9 (>15' to 19' 8")		>5.9 to 8.9 (>19' 8" to 29' 6")		>8.9 to 12 (>29' 6" to 39' 3")	
	Flue diameter mm, (in)							
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Up to 0.150, (Up to 1.6)	110 (4-3/8)	170 (6-5/8)	100 (4)	160 (6-1/4)	90 (3-5/8)	150 (5-7/8)	90 (3-5/8)	150 (5-7/8)
0.151 to 0.250, (1.6 to 2.69)	150 (6)	210 (8-1/4)	130 (5-1/8)	190 (7-3/8)	130 (5-1/8)	190 (7-3/8)	120 (4-3/4)	180 (7)
0.251 to 0.350, (2.69 to 3.77)	180 (7-1/8)	240 (9-3/8)	160 (6-3/8)	220 (8-5/8)	150 (6)	210 (8-1/4)	140 (5-5/8)	200 (7-3/4)
0.351 to 0.500, (3.77 to 5.38)	220 (8-3/4)	280 (11)	200 (7-7/8)	260 (10-1/8)	190 (7-1/2)	250 (9-3/4)	170 (6-3/4)	230 (9)
0.501 to 0.650, (5.38 to 6.99)	260 (10-1/4)	320 (12-1/2)	230 (9-1/8)	290 (11-3/8)	220 (8-3/4)	280 (11)	200 (7-7/8)	260 (10-1/8)
0.651 to 0.800, (6.99 to 8.60)	290 (11-1/2)	350 (13-3/4)	260 (10-1/4)	320 (12-1/2)	240 (9-1/2)	300 (11-3/4)	220 (8-3/4)	280 (11)
0.801 to 1.00, (8.60 to 10.76)	330 (13)	390 (15-1/4)	290 (11-1/2)	350 (13-3/4)	270 (10-3/4)	330 (12-7/8)	250 (9-7/8)	310 (12-1/8)
1.01 to 1.20, (10.76 to 12.91)	360 (14-1/4)	420 (16-1/2)	320 (12-5/8)	380 (14-7/8)	300 (11-7/8)	360 (14-1/8)	270 (10-3/4)	330 (12-7/8)
1.21 to 1.40, (12.91 to 15.06)	390 (15-3/8)	450 (17-5/8)	350 (13-7/8)	410 (16-1/8)	330 (13)	390 (15-1/4)	300 (11-7/8)	360 (14-1/8)
1.41 to 1.60, (15.06 to 17.22)	420 (16-5/8)	480 (18-7/8)	380 (15)	440 (17-1/4)	350 (13-7/8)	410 (16-1/8)	320 (12-5/8)	380 (14-7/8)
1.61 to 1.80, (17.22 to 19.37)	-	-	400 (15-3/4)	460 (18)	370 (14-5/8)	430 (16-7/8)	340 (13-1/2)	400 (15-3/4)
1.81 to 2.00, (19.37 to 21.52)	-	-	-	-	400 (15-3/4)	460 (18)	360 (14-1/4)	420 (16-1/2)
2.01 to 2.20, (21.52 to 23.67)	-	-	-	-	-	-	380 (15)	440 (17-1/4)

Note: Imperial conversions have been rounded up or rounded down depending on maximum or minimum.

Figure 10.12
Diameter of Round Flues for Fireplace Chimneys (9.21.2.5.)

Rectangular Flue Sizes for Fireplace Chimneys

Fireplace Opening m² (ft²)	Chimney Height, m, (ft-in) 3.0 to 4.5 (9' 10" to 15') Flue Size, mm, (in)		>4.5 to 5.9 (>15' to 19' 8")		>5.9 to 8.9 (>19' 8" to 29' 6")		>8.9 to 12 (>29' 6" to 39' 3")	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Up to 0.150, (1.6)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	100 x 200 (4 x 8)	100 x 200 (4 x 8)	100 x 200 (4 x 8)	100 x 200 (4 x 8)	100 x 200 (4 x 8)	100 x 200 (4 x 8)
0.151 to 0.250, (1.6 to 2.69)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	200 x 200 (8 x 8)
0.251 to 0.350, (2.69 to 3.77)	200 x 300 (8 x 12)	200 x 300 (8 x 12)	200 x 200 (8 x 8)	200 x 300 (8 x 12)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	200 x 200 (8 x 8)	200 x 200 (8 x 8)
0.351 to 0.500, (3.77 to 5.38)	300 x 300 (12 x 12)	300 x 300 (12 x 12)	200 x 300 (8 x 12)	200 x 300 (8 x 12)	200 x 300 (8 x 12)	200 x 300 (8 x 12)	200 x 200 (8 x 8)	200 x 300 (8 x 12)
0.501 to 0.650, (5.38 to 6.99)	300 x 300 (12 x 12)	300 x 400 (12 x 16)	300 x 300 (12 x 12)	300 x 300 (12 x 12)	300 x 300 (12 x 12)	300 x 300 (12 x 12)	200 x 300 (8 x 12)	200 x 300 (8 x 12)
0.651 to 0.800, (6.99 to 8.60)	300 x 400 (12 x 16)	300 x 400 (12 x 16)	300 x 300 (12 x 12)	300 x 400 (12 x 16)	300 x 300 (12 x 12)	300 x 300 (12 x 12)	300 x 300 (12 x 12)	300 x 300 (12 x 12)
0.801 to 1.00, (8.60 to 10.76)	400 x 400 (16 x 16)	400 x 400 (16 x 16)	300 x 400 (12 x 16)	300 x 400 (12 x 16)	300 x 400 (12 x 16)	300 x 400 (12 x 16)	300 x 300 (12 x 12)	300 x 300 (12 x 12)
1.01 to 1.20, (10.76 to 12.91)	400 x 400 (16 x 16)	400 x 400 (16 x 16)	400 x 400 (16 x 16)	400 x 400 (16 x 16)	300 x 400 (12 x 16)	300 x 400 (12 x 16)	300 x 400 (12 x 16)	300 x 400 (12 x 16)
1.21 to 1.40, (12.91 to 15.06)	-	-	400 x 400 (16 x 16)	400 x 400 (16 x 16)	400 x 400 (16 x 16)	400 x 400 (16 x 16)	300 x 400 (12 x 16)	300 x 400 (12 x 16)
1.41 to 1.60, (15.06 to 17.22)	-	-	-	-	400 x 400 (16 x 16)	400 x 400 (16 x 16)	400 x 400 (16 x 16)	400 x 400 (16 x 16)
1.61 to 1.80, (17.22 to 19.37)	-	-	-	-	-	-	400 x 400 (16 x 16)	400 x 400 (16 x 16)
1.81 to 2.00, (19.37 to 21.52)	-	-	-	-	-	-	400 x 400 (16 x 16)	400 x 400 (16 x 16)

Note: Imperial conversions have been rounded up or rounded down depending on maximum or minimum.

Figure 10.13
Rectangular Flue Sizes for Fireplace Chimneys (9.21.2.5.)

CHIMNEY LINERS

A chimney constructed of masonry or concrete must be lined with concrete, clay, firebrick, or metal. The liner must be installed at the time of chimney construction.

The joints of linings must be sealed to prevent any escape of smoke, fumes, or condensate into the assembly of the chimney. The mortar joints of clay or firebrick liners must be struck flush to make a smooth continuous surface that will reduce the build-up of soot on the liner.

Concrete liners must conform to Clause 4.2.6.4 of CAN/CSA-A405M, "Design and Construction of Masonry Chimney and Fireplaces."

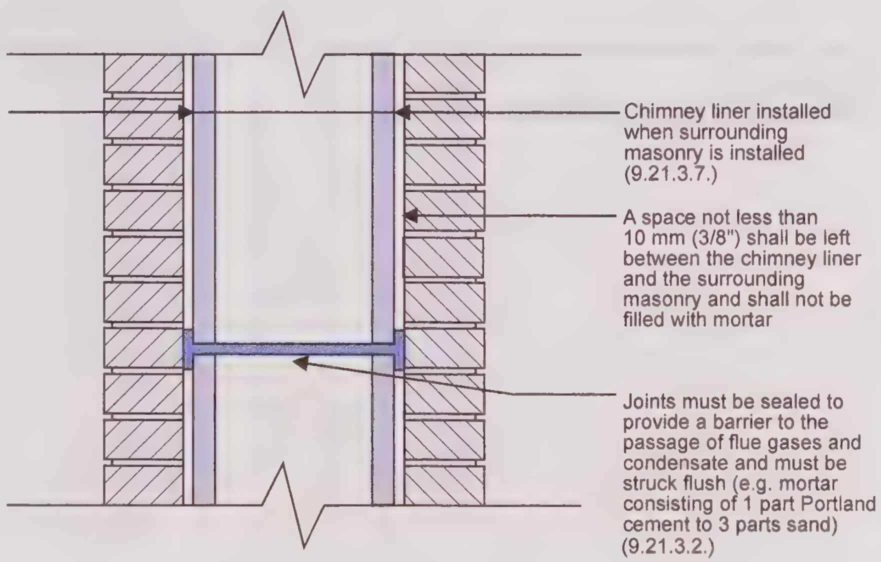


Figure 10.14
Allowable Space between Liners and Chimney Walls (9.21.3.8.)

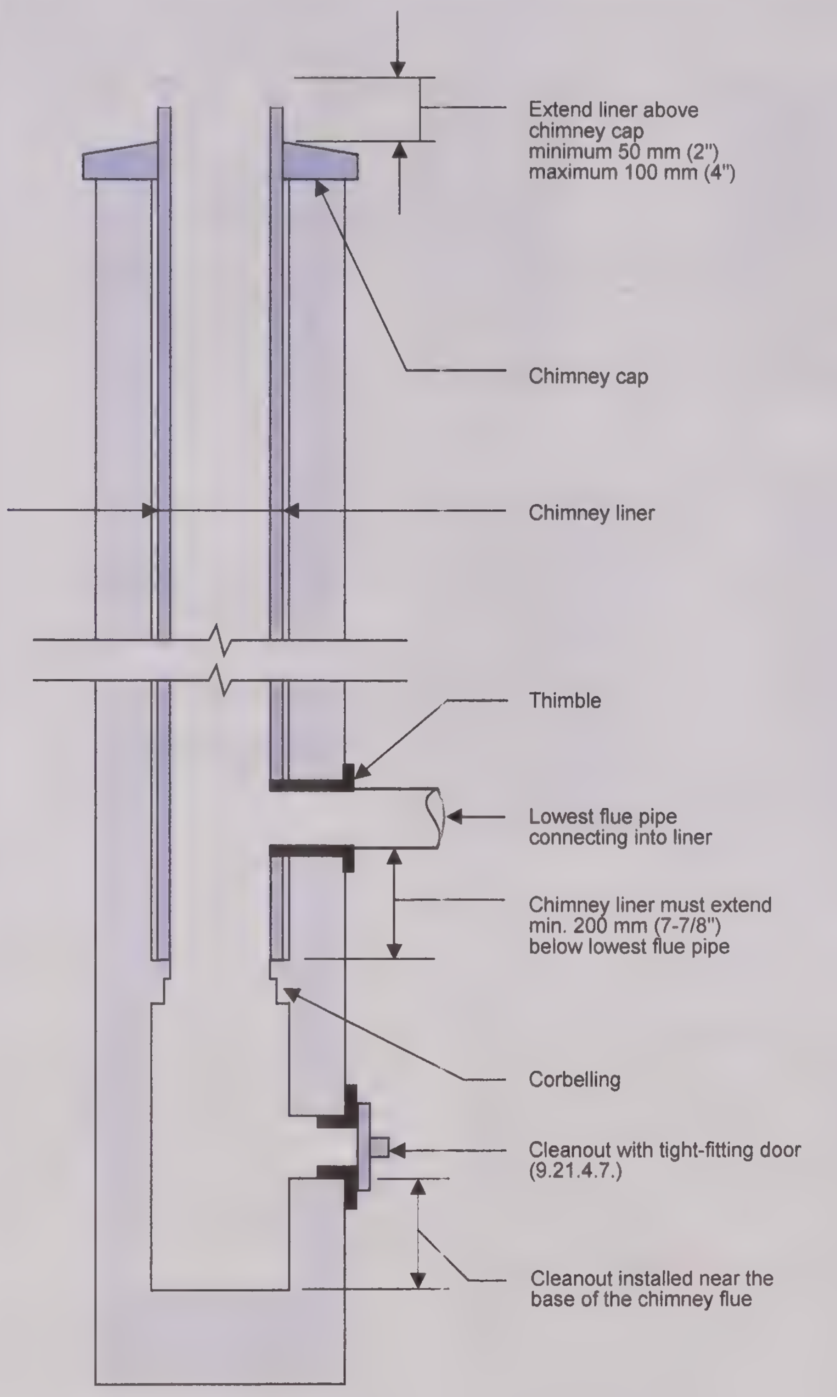


Figure 10.15
Chimney Liner Extensions (9.21.3.10.)

Clay liners must comply with CAN/CSA-A324M "Clay Flue Liners," be at least 15.9 mm (5/8") thick, and be able to resist softening, splitting, or cracking at temperatures up to 1100°C (2012°F).

Firebrick liners must comply with ASTM C27, "Classification of Fireclay and High Alumina Refractory Brick" and mortar for these liners must comply with CAN/CGSB 10.3, "Air Setting Refractory Mortar."

Metal liners must be constructed of stainless steel not less than 0.3 mm (0.012 in) thick. Metal liners may be used only in chimneys serving gas or oil burning appliances. Masonry chimneys serving solid fuel-burning appliances may be permitted to use a metal chimney liner if tests show that such liners will provide an equivalent level of safety as indicated in Article 9.22.10.2.

A space of not less than 10 mm (3/8") is required between the liner and the chimney walls. This space must not be filled with mortar. Refer to Figure 10.14.

Chimney liners used for solid fuel, gas, or oil burning appliances must be butted using mortar consisting of 1 part Portland cement to 3 parts sand by volume. Chimney liners used for solid fuel appliances may optionally use mortar that conforms to CAN/CGSB 10.3, "Air Setting Refractory Mortar."

A chimney liner is required to extend at least 200 mm (7-7/8") below the lowest flue pipe connected to it. The liner is also required to extend at least 50 mm (2") and not more than 100 mm (4") above the chimney cap. Refer to Figure 10.15.

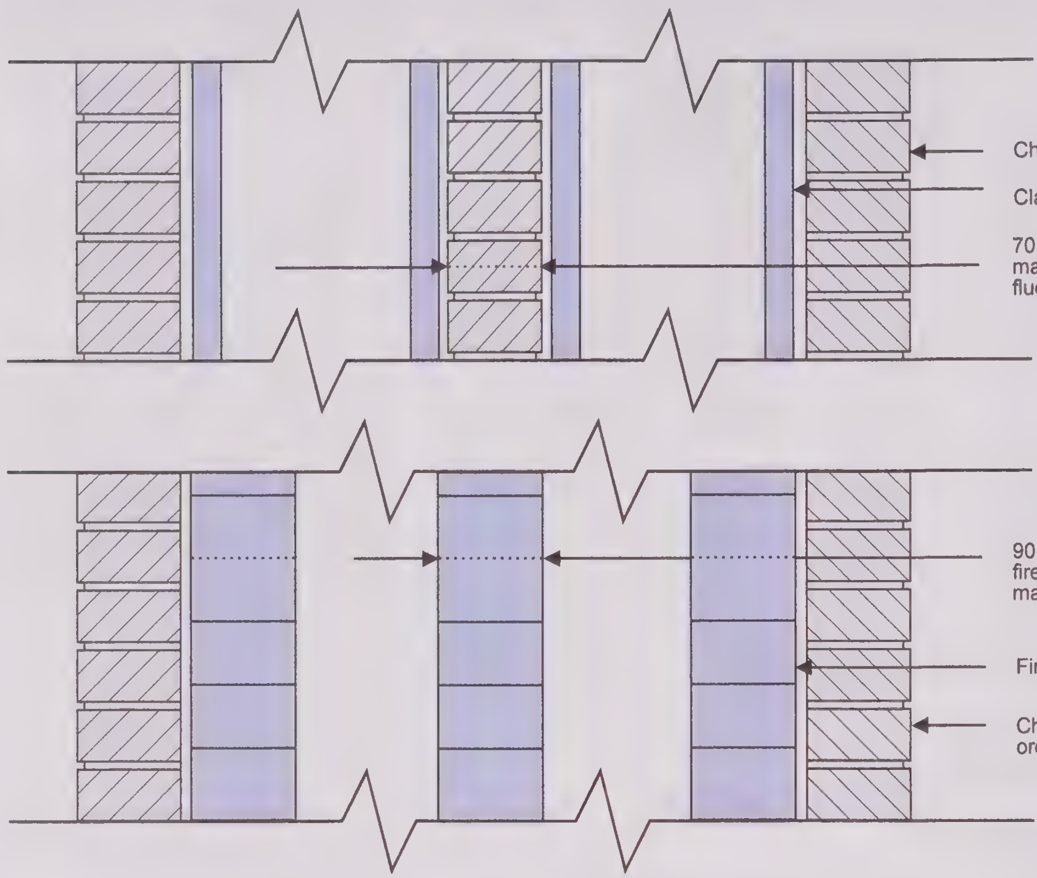


Figure 10.16
Separation of Chimney Flues in the Same Chimney

(9.21.4.8.)
(9.21.4.9.)

Masonry and Concrete Chimneys

The wall thickness of a chimney must be at least 70 mm (2-3/4") solid masonry excluding the liner thickness. The separation of flues, where more than one are in a chimney, requires 70 mm (2-3/4") of masonry or concrete (not including the liner thickness), or at least 90 mm (3-1/2") of firebrick may be used. Refer to Figure 10.16.

A chimney must be in all cases at least 900 mm (2' 11") above the highest point that the chimney contacts a roof. Refer to Figure 10.17. A chimney must also be not less than 600 mm (23-5/8") above any part of the roof that is within 3 m (9' 10") of the chimney. A chimney does not need to be laterally braced if it extends not more than 3.6 m (11' 10") above the roof or masonry wall and has no horizontal outside dimension less than 400 mm (15-3/4"). When lateral bracing is required to provide stability under wind loads, chimneys must conform to Subsection 4.3.2. in the Code and be designed by a competent individual.

A cap that is waterproof and constructed with reinforced concrete, masonry, or metal must be placed on the top of the chimney. This cap must allow water run-off and provide a drip not less than 25 mm (1") from the chimney wall on the underside of the capping projection.

Caps that are cast-in-place concrete only require a sufficient space between the cap and the liner to fill with a bond break. Refer to Figure 10.18. Caps that are precast concrete or masonry require a space for a bond break as well as flashing which is sealed to the liner and runs out under the cap. Refer to Figure 10.19.

A cleanout must be provided for chimneys that do not serve a masonry fireplace. A tight fitting metal door must be provided at the bottom of the chimney. Refer to Figure 10.15.

Flashing must be provided at junctions with adjacent materials to restrict the penetration of water into the chimney and the building envelope.

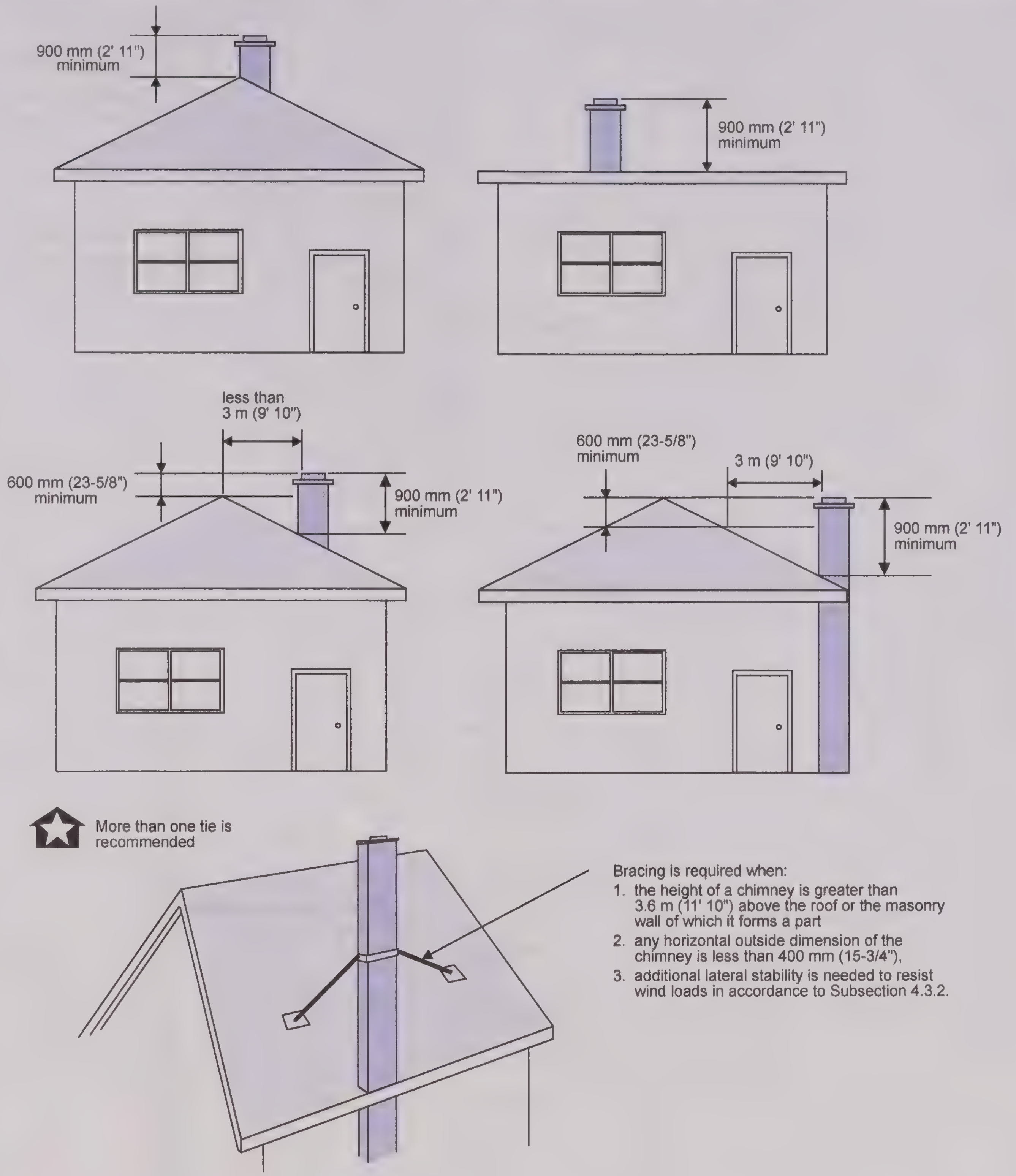


Figure 10.17
Height of Chimney Flues

(9.21.4.4.)
(9.21.4.5.)

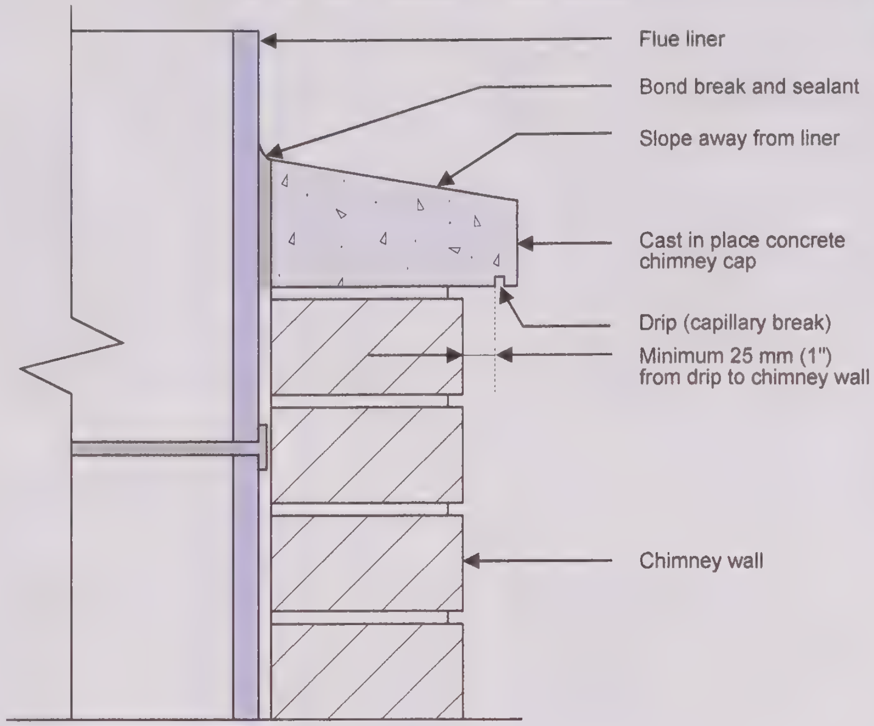


Figure 10.18
Cast in Place Chimney Cap (9.21.4.6.)

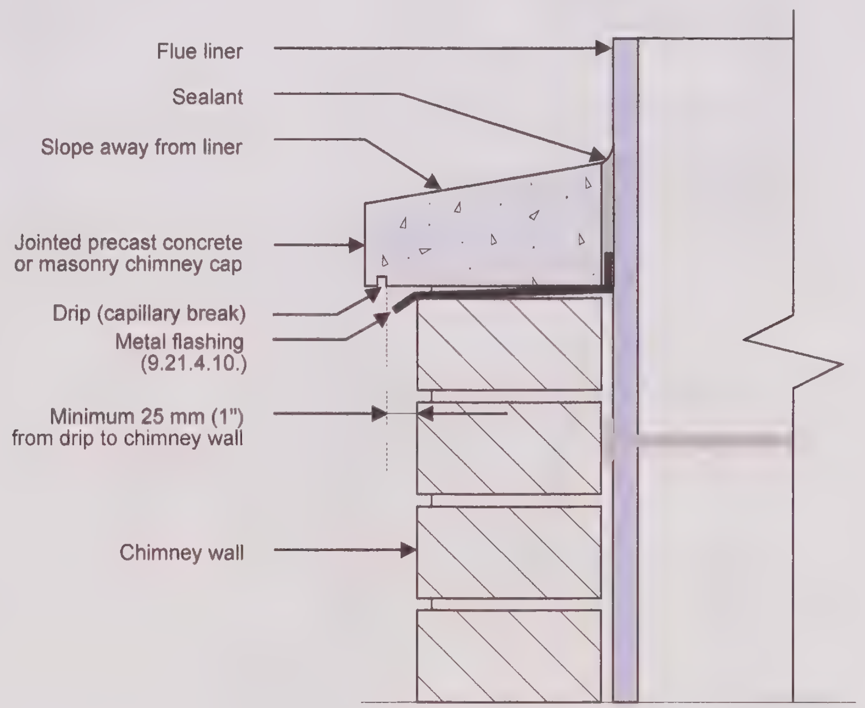


Figure 10.19
Precast Concrete or Masonry Chimney Cap (9.21.4.6.)

Excerpts from: CAN/CSA B365 "Installation Code for Solid-Fuel-Burning Appliances & Equipment"

Please consult the standard for full details.

Note: **Some chimney manufacturers do not recommend the use of their chimney sections for this application.**

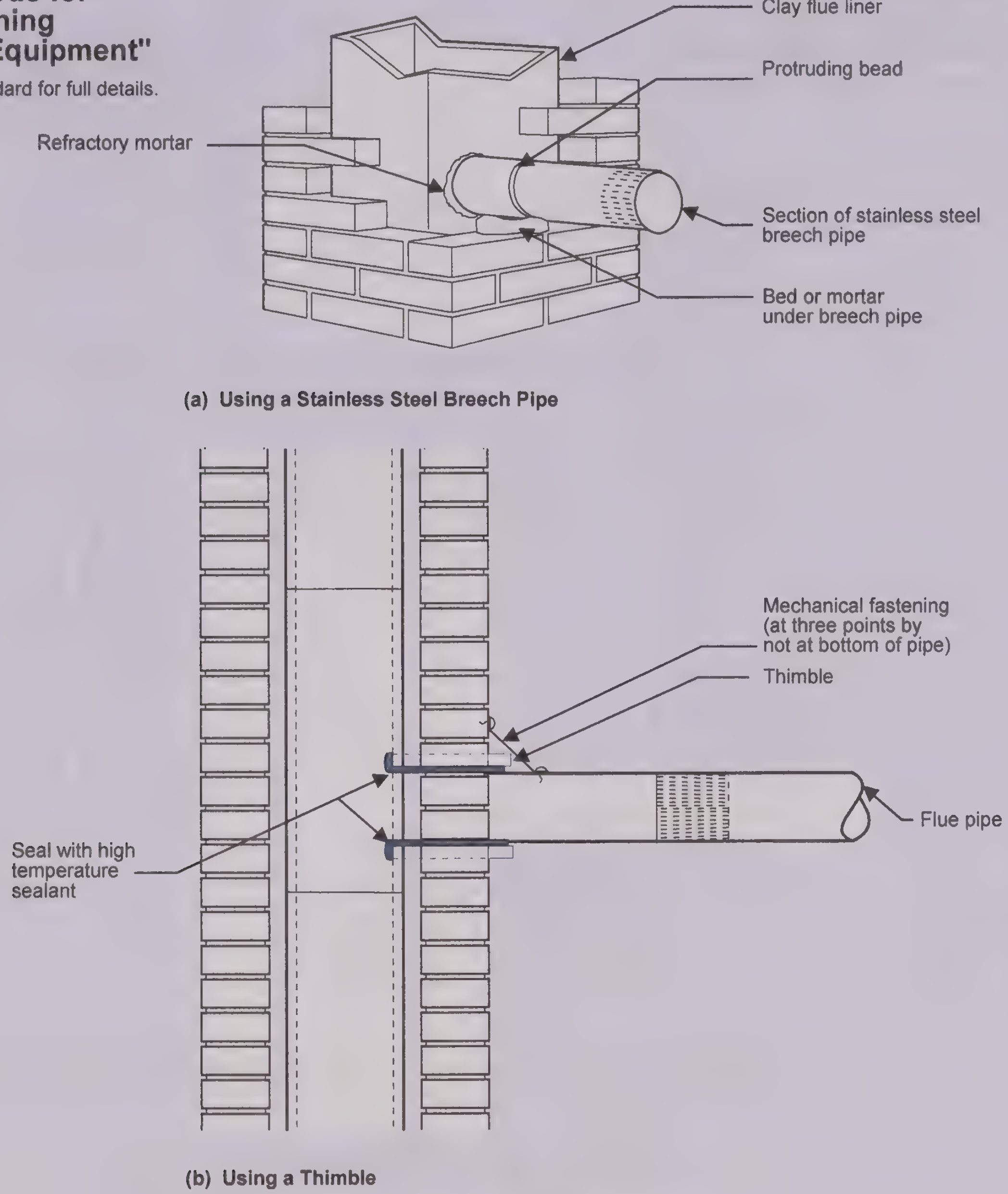
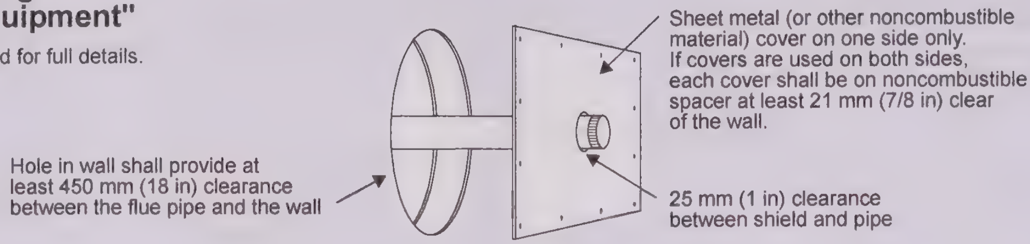


Figure 1 - Attachment of a Flue Pipe to a Masonry Chimney

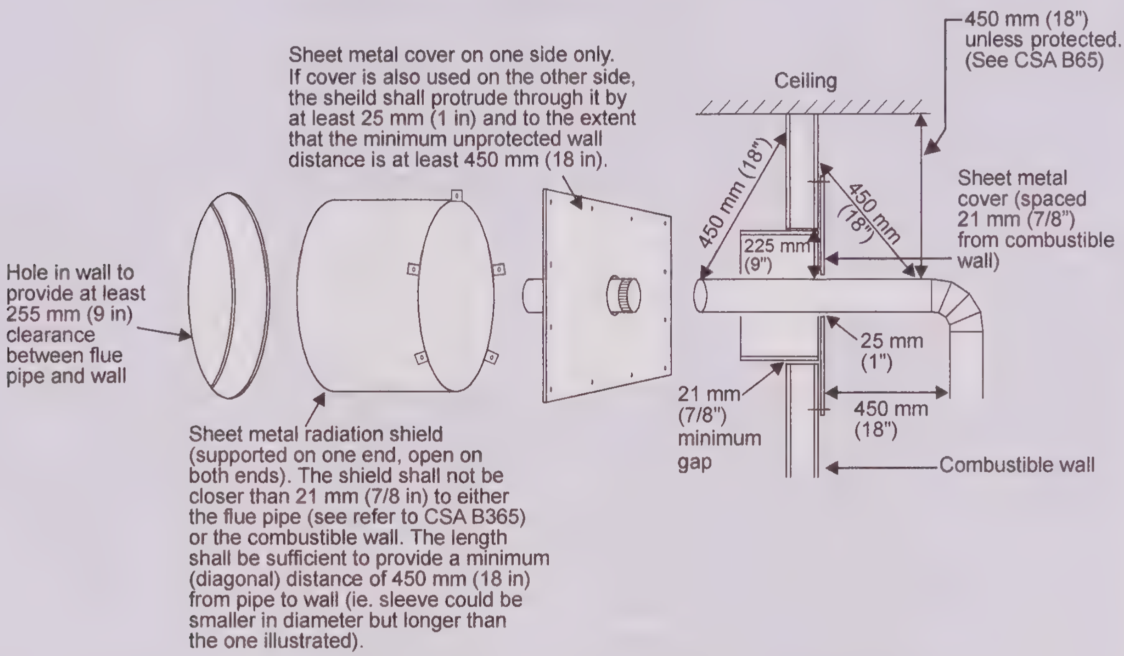
Excerpts from: CAN/CSA B365 "Installation Code for Solid-Fuel-Burning Appliances & Equipment"

Please consult the standard for full details.

Note: Some chimney manufacturers do not recommend the use of their chimney sections for this application.



(a) Flue Pipe Installation Through a Wall of Combustible Material - No Protection



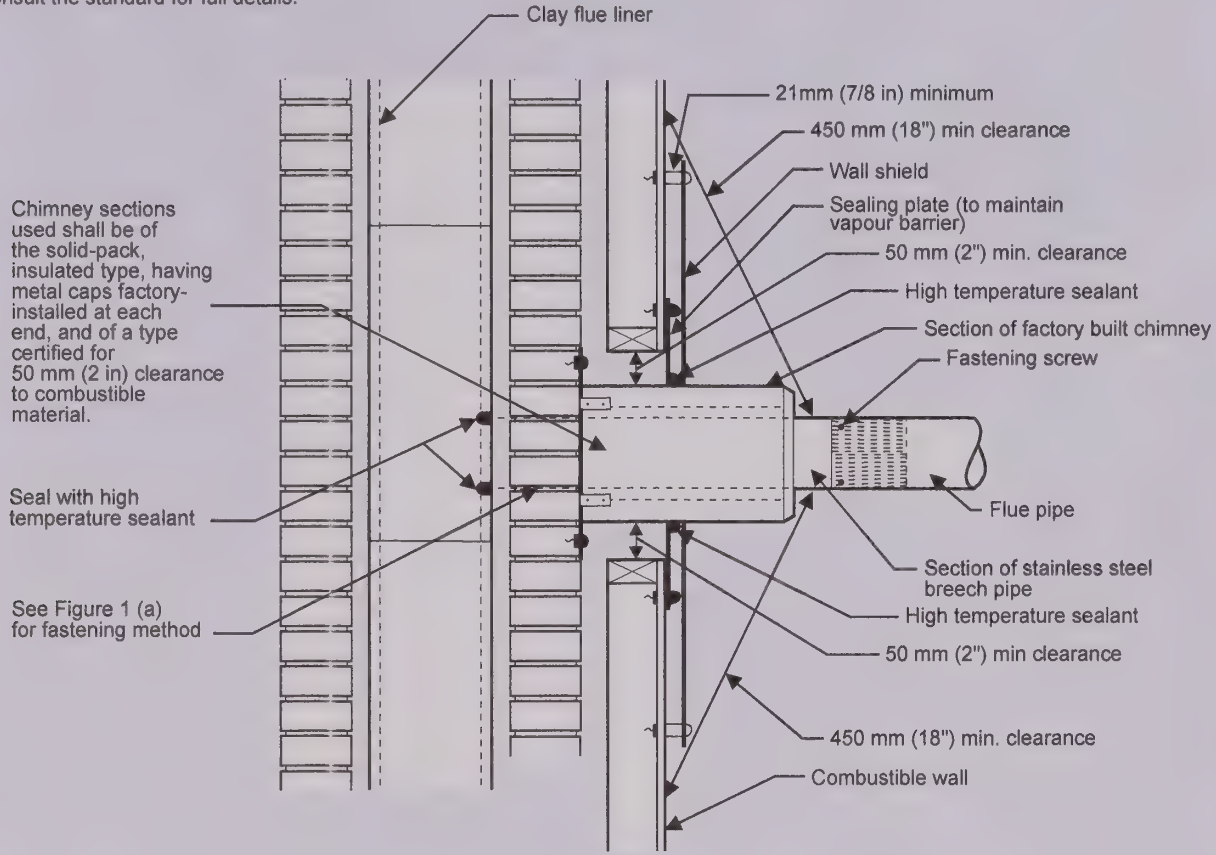
(b) Flue Pipe Installation Through a Wall of Combustible Material - Sheet Metal Protection

Figure 2
Passing a Flue Pipe Through a Wall of Combustible Material

Excerpts from: CAN/CSA B365 "Installation Code for Solid-Fuel-Burning Appliances & Equipment"

Please consult the standard for full details.

Note: Some chimney manufacturers do not recommend the use of their chimney sections for this application.



(c) Flue Pipe Installation Through a Wall of Combustible Material into a Masonry Chimney (Interior or Exterior) Using a Length of Factory-Built Insulated Chimney as a Radiation Shield

Figure 2
Passing a Flue Pipe Through a Wall of Combustible Material

11 MECHANICAL SYSTEMS

Mechanical systems in housing typically deliver space heating and cooling (air-conditioning), ventilation and domestic water heating. Chapter 12 deals with some of the key plumbing requirements in the Code. It's not always easy to separate mechanical systems from plumbing and electrical systems in modern housing, especially where they are integrated by sophisticated technologies. A review of each of the systems, their interrelations and their respective Code requirements is always necessary prior to finalizing a design and commencing construction.

Space heating systems must be adequately sized to deliver enough heat to maintain minimum inside design temperatures. Heat must then be distributed to all rooms or habitable spaces to maintain indoor design temperatures that satisfy occupant comfort requirements. The same consideration should also be given to cooling systems.

KEY POINTS

Mechanical systems must be designed and installed to fulfill the following functions:

- deliver adequate heating to all occupied rooms of a dwelling unit to satisfy occupant comfort requirements;
- deliver adequate cooling (where desired) to all occupied rooms of a dwelling unit to satisfy occupant comfort requirements;
- allow capacity to deliver adequate fresh air to promote occupant health and safety; and
- allow access for servicing and maintenance of all installed equipment.

Ventilation provides minimum outdoor air needed for occupants. Furthermore it helps to respond to recent improvements in envelope air tightness and the need to control unhealthy levels of indoor air contaminants from building materials, furnishings and occupant lifestyles. The ability of mechanical ventilation systems to provide adequate, occupant controlled rates of ventilation is now recognized as a minimum Code requirement. The impact of ventilation system operation on dwelling unit pressure imbalances and spillage susceptible combustion equipment has also been recognized.

The integration of mechanical system functions is becoming increasingly common and viable. Whether employing an integrated mechanical system or a number of conventional, separate systems to heat, cool and ventilate the dwelling unit, consideration should be given to the layout of equipment, ducts and piping. Equipment noise, for instance, can be significantly reduced with the appropriate preplanning. Preplanning and appropriate system selection can also reduce possible conflicts between mechanical and other dwelling unit systems including the structural and envelope systems.

HEATING AND AIR CONDITIONING

BUILDING CODE REFERENCES

DIVISION B

6.2.1.4.	Installation Standards
6.2.4.3.	Construction and Installation of Ducts and Plenums
6.2.4.7.	Return-Air System
6.2.4.8.	Coverings, Linings and Insulation
6.2.4.10.	Clearances of Ducts and Plenums
6.2.5.1.	Location of Appliances
6.2.8.1.	Lining or Backing
9.33.1.1.	Design and Installation Requirements
9.33.1.2.	Solid Fuel-Burning Appliances
9.33.3.1.	Indoor Design Temperatures
9.33.3.2.	Outdoor Design temperatures

This section deals with the space heating and air conditioning (cooling) systems in housing as governed by the requirements of Section 9.33. of the Code. Part 6 of the Code also contains many requirements for mechanical systems that extend beyond the prescriptive provisions of Part 9. In most cases, competent design is required in applying the requirements of Part 6.

Due to the range of available heating and cooling equipment and the highly specialized nature of the technology, a number of related standards are referenced in Section 9.33. and Part 6. These referenced standards together with the specific provisions of the Code govern the selection of heating and cooling equipment, system design and installation.

Design and Installation Requirements

Section 9.33. and Part 6 of the Code require that heating and air-conditioning systems be designed, constructed and installed in accordance with good engineering practice such as described in the applicable HRAI (Heating, Refrigerating and Air-Conditioning Institute) publications, ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Handbooks and Standards and other applicable standards listed in Sentence 6.2.1.1.(1) and Article 6.2.1.4. of the Code.

The capacity of heating and cooling appliances can be determined using CAN/CSA-F280, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances." Alternative methods or standards conforming to good engineering practice are also permitted, provided design temperatures conform to Supplementary Standard SB-1 of the Code.

Earth energy systems are permitted to be installed for use in dwelling units and small buildings if they are designed and installed in accordance with CAN/CSA-C448.2, "Design and Installation of Earth Energy Systems for Residential and Other Small Buildings."

Access to mechanical equipment for maintenance and inspection purposes is required in all installation standards. Equipment must also be protected from freezing. Refer to Chapter 6 of this Guide for the fire protection requirements that may apply. Figure 11.1 identifies among other things the clearance from combustibles for heating supply ducts.

Contact local utilities and verify all requirements for the heating and cooling system options being considered. In Ontario, the Technical Standards and Safety Authority regulates the installation of oil and gas furnaces. Only certified technicians are permitted to install these systems.

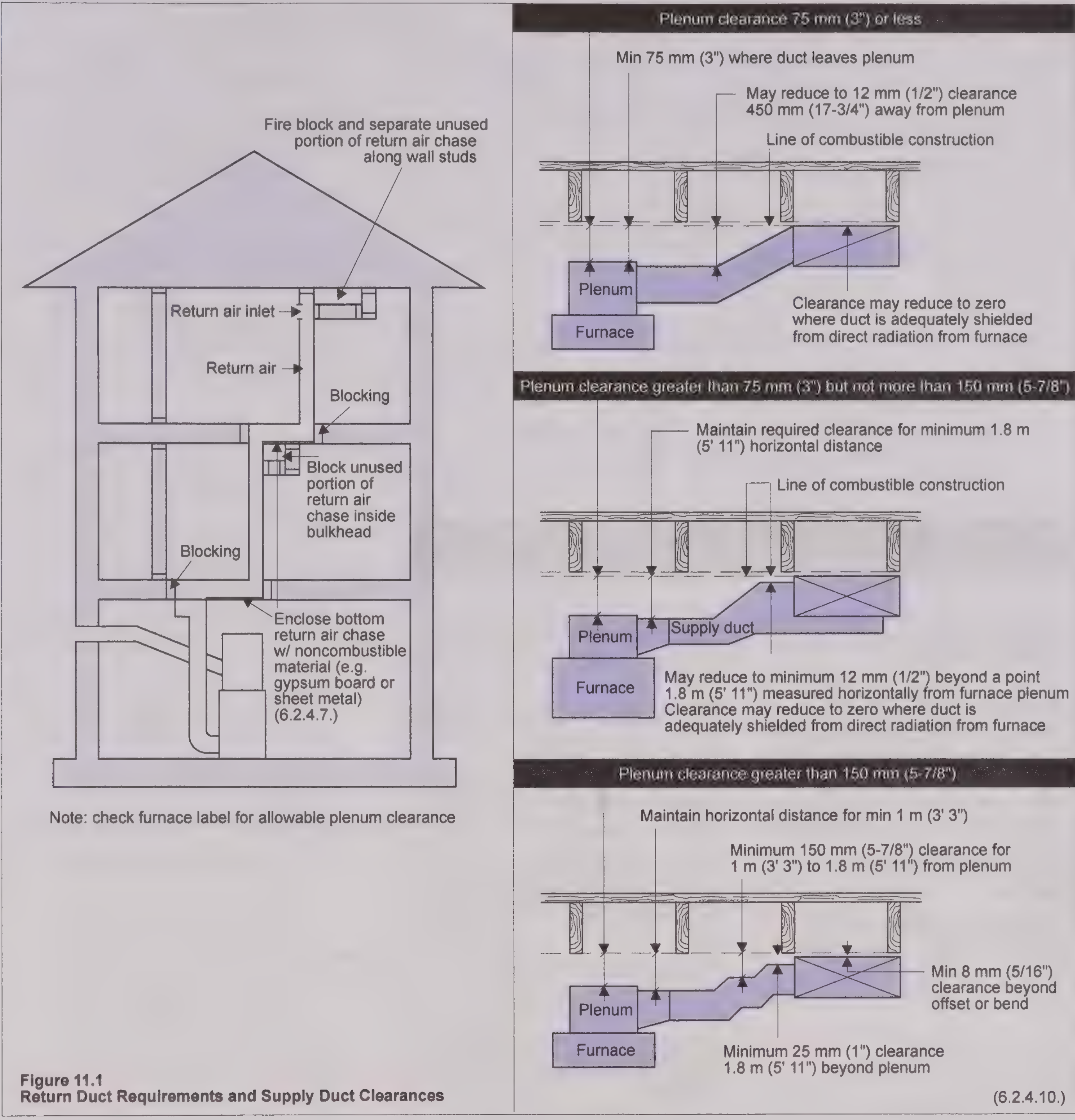
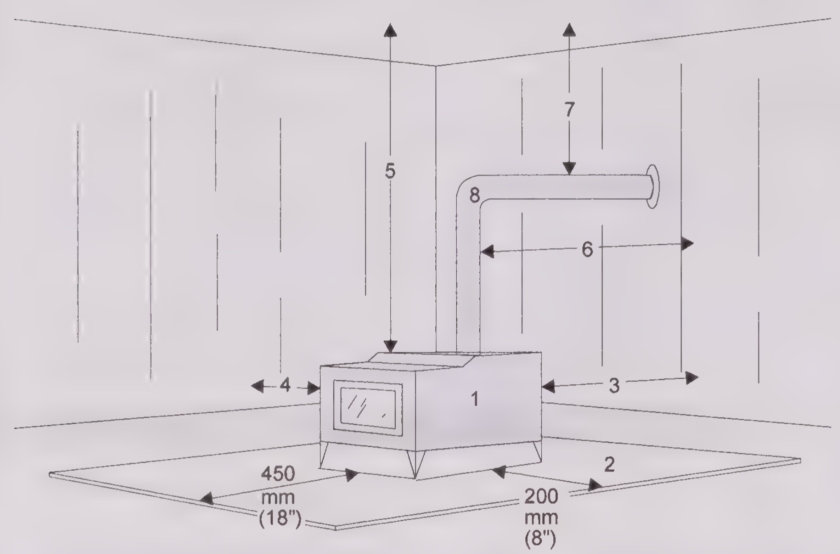
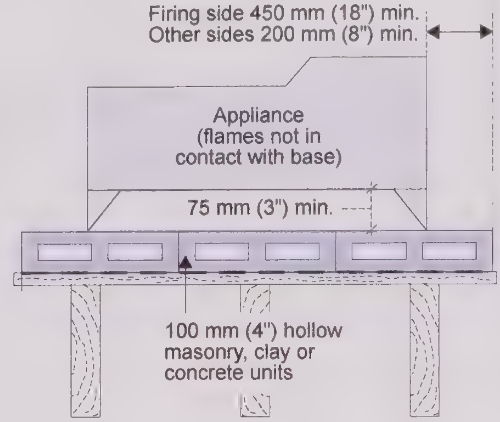


Figure 11.1
Return Duct Requirements and Supply Duct Clearances

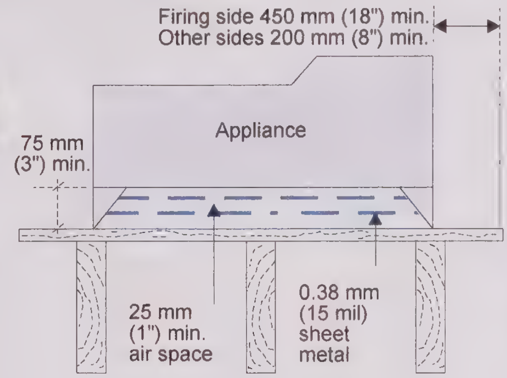


Legend	
1 Listed appliances under CAN/CSA-B365 "Installation Code for Solid Fuel-Burning Appliances and Equipment"	**1** Existing/non-listed appliances under CAN/CSA-B365 "Installation Code for Solid Fuel-Burning Appliances and Equipment"
2 Floor protector on combustible floor or floor covering may be a laboratory listed type protector or may consist of a layer of 0.38 mm (15 mil) thick sheet of metal or a grouted ceramic floor tile surface installed in accordance with the Building Code extending at least 450 mm (18") beyond any side having a door, and 200 mm (8") beyond the appliance on the other sides	**2** Floor protector on combustible floor or floor covering may be a laboratory listed type protector or may consist of a layer of 0.38 mm (15 mil) thick sheet of metal or a grouted ceramic floor tile surface installed in accordance with the Code extending at least 450 mm (18") beyond any side having a door, and 200 mm (8") beyond the appliance on the other sides
3,4,5 These clearances are set by the manufacturer and certified by the testing laboratory	**3,4** Minimum clearance at sides and rear is 1200 mm (48") for non-shielded appliances. Shielded appliances require 900 mm (36") at rear and 1200 mm (48") at sides
6,7 Clearance between flue pipe and combustibles is 450 mm (18") minimum	**5** Top clearance is 1500 mm (60") for all types of appliances using solid fuel in accordance with CAN/CSA-B365
	6,7 Minimum clearance from flue pipe to combustibles is 450 mm (18") except where such combustibles are suitably protected
	8 1200 mm (48") front or fueling side clearance

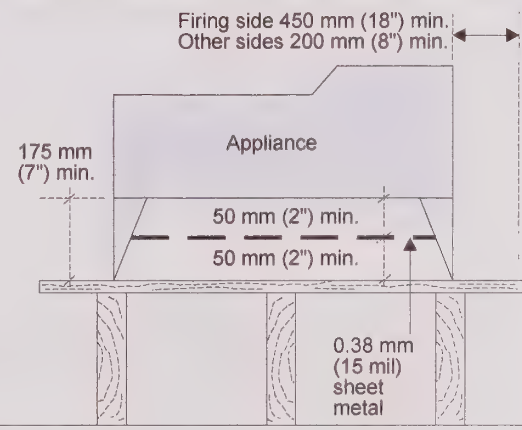
Option 1: Hollow Masonry Units



Option 2: Directly on Floor with Two Metal Plates



Option 3: Directly on Floor with Greater Clearance



Note:
In the case where a difference exists between the manufacturer's installation instructions and the requirements of the Standard, the installation instructions shall govern.

Figure 11.2
Solid Fuel-Burning Appliance Requirements Derived from CAN/CSA-B365 (9.33.1.2.)

Solid Fuel-Burning Appliances

The installation of solid fuel-burning stoves, cooktops and space heaters including requirements for combustion air are governed by CAN/CSA-B365, "Installation Code for Solid Fuel- Burning Appliances and Equipment". This CSA standard covers issues such as accessibility, air for combustion and ventilation, chimney and venting, mounting and floor protection, wall and ceiling clearances, installation of ducts, pipes, thimbles and manifolds, and control and safety devices. Solid fuel-burning appliances must also meet particulate emission limits as established in the standards listed in Article 9.33.1.2.

The use of solid-fuel burning appliances can trigger additional requirements. Ensure that all equipment and materials are certified and comply with the applicable standards cited in CAN/CSA-B365. Figure 11.2 illustrates the most important considerations relating to the installation of woodstoves. Fireplaces are discussed in Chapter 10 in this guide.

Looking Back

Chapter 10 Fireplaces, Chimneys, and Flues

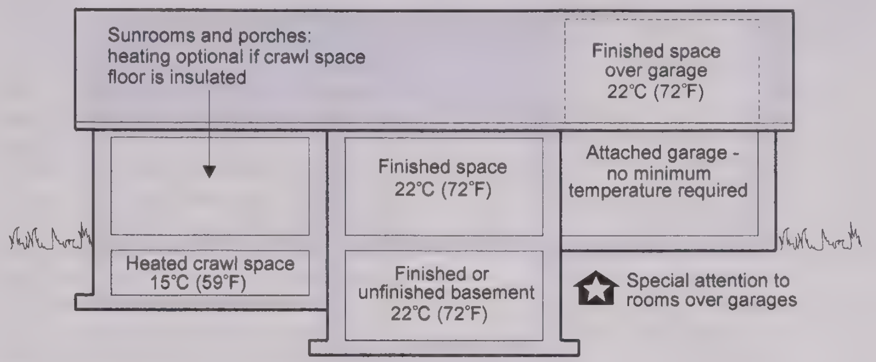


Figure 11.3
Heating System Indoor Design Temperatures (9.33.3.1.)

Design Temperatures

The Code states that buildings intended for occupancy in the winter months on a continuous basis must be equipped with space heating equipment capable of maintaining a minimum indoor temperature at the outside winter design temperature. The outside temperature to be used in determining the capacity of heating systems shall be the January 2.5% design temperature corresponding to the appropriate municipality as set out in Supplementary Standard SB-1 of the Code.

Heating equipment must be capable of maintaining a minimum indoor temperature of 22°C (72°F) in dwelling units, including basements and rooms over garages. For heated crawlspaces, the heating system must be capable of maintaining a temperature of no less than 15°C (59°F). Figure 11.3 depicts the heating system indoor design temperatures specified in the Code.

Where air-conditioning equipment is installed, the system capacity must be determined using the July 2.5% dry bulb design temperature corresponding to the appropriate municipality as set out in Supplementary Standard SB-1. The cooling system should be capable of maintaining an indoor temperature in conditioned spaces of no higher than 24°C (75°F).

The sizing of heating and cooling equipment to maintain required indoor temperatures is detailed in reference standard CAN/CSA-F280-M, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances".

DOMESTIC WATER HEATING

BUILDING CODE REFERENCES

DIVISION B

9.31.6.2.	Equipment and Installation
9.31.6.3.	Corrosion-Resistant Coating
9.31.6.4.	Fuel-Burning Heaters
9.31.6.5.	Heating Coils
9.33.1.3.	Structural Movement

Domestic water heating or service water heating requirements as they pertain to plumbing may be found in Chapter 12 of this Guide. Domestic water heaters and their installation must conform to the requirements of Part 6 of the Building Code if they provide space heating.

Storage tanks for domestic water heaters fabricated from corrosion-susceptible materials such as steel must be coated with zinc, vitreous enamel (glass lined), hydraulic cement or other corrosion-resistant material. This requirement is intended to promote acceptable water quality as well as storage tank durability.

Service water heaters must be secured to the structure to resist overturning in areas of high seismic activity (where the spectral response acceleration is greater that 0.55 as noted in Supplementary Standard SB-1 of the Code (e.g. Ottawa).

Fuel-burning service water heaters must be connected to a chimney flue conforming to the requirements of Section 9.21. of the Code, which are described in Chapter 10 of this Guide. Heating coils of service water heaters must not be installed in a flue or in the combustion chamber of a boiler or furnace.

VENTILATION

BUILDING CODE REFERENCES

DIVISION B

6.2.1.6.	Heat Recovery Ventilators
6.2.4.3.	Construction and Installation of Ducts and Plenums
9.32.1.1.	Application
9.32.1.2.	Mechanical Ventilation for Dwelling Units
9.32.1.3.	Ventilation of Rooms and Spaces
9.32.2.1.	Natural Ventilation Area
9.32.2.2.	Protection from Weather and Insects
9.32.3.1.	General
9.32.3.2.	Required Mechanical Ventilation
9.32.3.3.	Total Ventilation Capacity
9.32.3.4.	Principal Exhaust
9.32.3.5.	Supplemental Exhaust
9.32.3.6.	Ventilation Systems Coupled with Forced Air Heating Systems
9.32.3.7.	Ventilation Systems Not Coupled with Forced Air Heating Systems
9.32.3.8.	Protection Against Depressurization
9.32.3.9.	Fan Ratings
9.32.3.10.	Ducts
9.32.3.11.	Heat Recovery Ventilators
9.32.3.12.	Outdoor Intake and Exhaust Openings
9.32.3.13.	Installation
12.3.1.3	Temperature Control in Dwelling Units
12.3.1.5	Residential Furnaces After December 31, 2014

This part of the Guide reviews the ventilation requirements of the Code. These are found primarily in Code Section 9.32. and address the ventilation of rooms and spaces in dwelling units both mechanically and by natural means. Section 9.32. governs mechanical ventilation systems that serve only one dwelling unit. Mechanical ventilation systems other than self-contained systems serving single dwelling units must conform to the provisions of Part 6 of the Building Code. Part 6 requires the involvement of a competent designer or installer.

Every dwelling unit that has electrical power must be provided with a mechanical ventilation system that conforms to the Code. The occupants must be capable of operating the mechanical ventilation system on a year-round basis. Individual rooms and spaces may be ventilated naturally or mechanically.

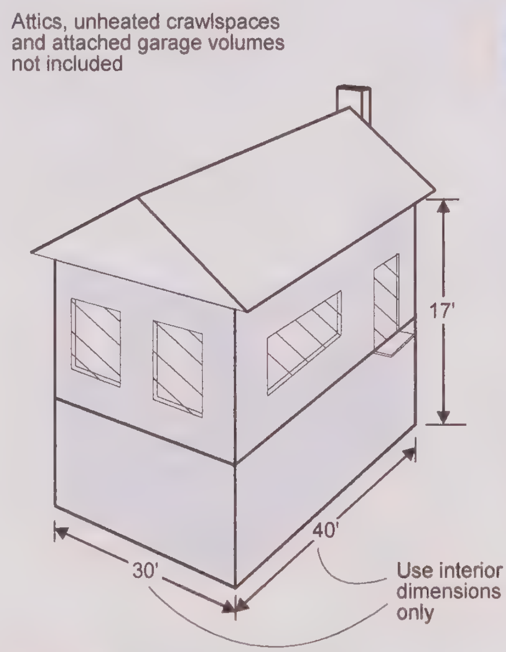
Natural Ventilation

Rooms and spaces that are ventilated by natural means must have unobstructed openable ventilation areas, typically windows, to the outdoors. Figure 11.4 identifies the minimum unobstructed areas that are required for natural ventilation within dwelling units. Openings, other than windows, that have been provided for natural ventilation must be protected from the weather and from insects. As well, screening must be made of rust-proof material.

Rooms or spaces in a dwelling unit that have not been provided with openings for natural ventilation must be ventilated mechanically as noted in Subsection 9.32.1. of the Code. Mechanical ventilation for these spaces must provide one-half (0.5) air change per hour if the room or space is mechanically cooled in the summer or 1.0 air change per hour if the space is not mechanically air-conditioned. Figure 11.5 shows how to calculate the volume of air that corresponds to the air change rate.

Natural Ventilation		
	Location	**Minimum Unobstructed Area**
Within dwelling unit	Bathrooms or water closet rooms	0.09 m² (0.97 ft²)
	Unfinished basement space	0.2 percent of the floor area
	Dining rooms, living rooms, bedrooms, kitchens, combined rooms, dens, recreation rooms and all other finished rooms	0.28 m² (3 ft²) per room or combination of rooms

Figure 11.4
Natural Ventilation (9.32.2.1.)



Rate of Air Exchange Calculation

1 air changes per hour
= 30' x 40' x 17'
= 19200 cubic feet per hr
= 19200/60 minutes
= **320 cfm** (cubic ft. per minute)

0.3 air changes per hour
= 0.3 x 19200
= 5760 cubic ft/hr
= 5760/60 minutes
= **96 cfm** (cubic ft. per minute)

Dwelling units containing rooms or spaces without natural ventilation may require a higher ventilation system capacity

Figure 11.5
Calculating Rate of Air Exchange (9.32.1.3.(3))

Mechanical Ventilation

There are essentially two acceptable approaches available for the design and installation of mechanical ventilation systems:

- for specific applications the mechanical ventilation system can conform to Section 9.32. of the Code or

- the mechanical ventilation system conforms to Part 6 of the Code.

The requirements of Part 6 in the Code are not presented here. Below are some details of the specific applications that allow a mechanical ventilation system to conform to Section 9.32. of the Code.

The Code defines four types of dwelling units that establish which Part of the Code applies. Part 6 can be used for any of the four types. Part 9 can only be used for Type I, Type II or Type IV dwelling units (see Dwelling Unit Type Definitions on the next page). Part 6 must be used for the design and installation of all mechanical ventilation systems for Type III dwelling units. In other words, the mechanical ventilation provisions of Part 9 cannot be used for Type III dwelling units. In addition, Part 6 must be used for all dwelling units with more than 5 bedrooms.

A heat recovery ventilator must be provided for all Type IV dwelling units that contain non-forced air electric space heating and for all Type II dwelling units.

Total Ventilation Capacity

The minimum total ventilation capacity of the entire ventilation system must be 0.3 air changes per hour based on the conditioned volume of the dwelling unit or the sum of the individual room capacities as shown in Figure 11.6, whichever is greater. The greater value between these two values will be the overall required ventilation capacity for the entire dwelling unit.

Principal Exhaust Fan

One of the exhaust fans of the ventilation system must be identified as the principal exhaust fan. This can be the fan within a heat recovery ventilator (HRV) or, in some cases, a point exhaust fan. The principal exhaust fan is intended to operate continuously, dealing with indoor pollutants that are generated from occupancy. The required capacity of the fan can be calculated from the total number of bedrooms in the building as shown in Figure 11.7. Part 6 of the Building Code must be used for all dwelling units with more than 5 bedrooms.

The principal exhaust fan must be controlled by a manual switch. A humidistat or other automatic control can be used provided a manual override exists. The switch must be centrally located within the dwelling unit and must be marked with the words VENTILATION FAN. Where the capacity of the principal exhaust fan exceeds the required minimum capacity of Figure 11.7 by more than 50%, the controls must allow the fan capacity to be adjusted to within +/-10% of the required minimum capacity.

The principal exhaust fan may be connected directly to a forced air heating system. In these cases the principal exhaust fan must withdraw air from the return side of the system with the exhaust connected not less than 1 m (3' 3") upstream from an outdoor supply duct.

The principal exhaust fan may exhaust from any room including the kitchen. Where the fan exhausts from a kitchen, the intake must be located in the ceiling or on the wall within 300 mm (11-3/4") from the ceiling.

Ventilation Capacity

Room	Capacity L/s (cfm)
Master bedroom [1]	10 (21.2)
Other bedrooms	5 (10.6)
Living room [2]	5 (10.6)
Dining room [2]	5 (10.6)
Kitchen	5 (10.6)
Family room [2]	5 (10.6)
Recreation room	5 (10.6)
Basement [3]	10 (21.2)
Other habitable rooms [4]	5 (10.6)
Bathroom or water closet room	5 (10.6)
Laundry room	5 (10.6)
Utility room	5 (10.6)

Notes
1 At least one bedroom in each dwelling unit shall be designated as the master bedroom.
2 Ventilation capacities assigned to any combined living/dining or family/dining space shall be determined as if the spaces were individual rooms.
3 Where a basement incorporates rooms of the types designated in this table, the assigned ventilation capacities for each room shall be specified for those types of rooms. Basement areas used for other purposes that exceed 2/3 of the total basement floor area shall be assigned a fan capacity of 10 L/s (21.2 cfm). Those that are less than 2/3 of the total floor area shall be assigned 5 L/s (10.6 cfm).
4 Other habitable rooms shall be assigned a ventilation capactiy of 5 L/s (10.6 cfm). This does not include spaces intended solely for access, egress, storage or service equipment.

Figure 11.6
Ventilation Capacity (9.32.3.3.)

Principal Exhaust Fan Capacity

Number of bedrooms in dwelling unit	Capacity L/s (cfm)
1	15 (31.8)
2	22.5 (47.7)
3	30 (63.6)
4	37.5 (79.5)
5	45 (95.4)
More than 5	System must comply with Sentence 6.2.1.1.(1)

Figure 11.7
Principal Exhaust Fan Capacity (9.32.3.4.)

Supplemental Fans

Kitchens and bathrooms that are not served by the principal exhaust fan must have supplemental exhaust fans installed. There is no minimum exhaust requirement for these fans. However, the principal and supplemental fans must at least equal the total ventilation capacity.

The exhaust fans from kitchens, with the exception of range hoods, must be installed on the ceiling or no more than 300 mm (11-3/4") from the ceiling if installed on a wall. Required supplemental fans must be controlled by a manual switch located in each room served even when a shared supplemental exhaust system is used, such as a central fan or heat recovery ventilator (HRV). Where the principal exhaust fan serves rooms required to have supplemental exhaust, it should be controlled by a manual switch wired in parallel to the required master manual switch for principal exhaust systems.

Ducts that serve the principal exhaust fan or supplementary exhaust fans may be chosen under limited applications and based on Tables 9.32.3.4.B and 9.32.3.5. of the Code or designed in accordance with Part 6 of the Code.

Ventilation Systems Not Coupled with Forced Air Heating Systems

Mechanical ventilation can be provided without integrating the ventilation system to that of the forced air heating system.

In this type of system, ventilation air is distributed throughout the dwelling unit, including to each bedroom, to each storey without a bedroom and to principal living areas in basements. Distribution must be provided by a supply duct from the outdoors and a main trunk duct must be sized according to Tables 9.32.3.7.A and 9.32.3.7.B or Part 6 of the Code. Provisions must be made for the free flow of air to all rooms by leaving gaps beneath doors, using louvered doors or installing grilles in doors. A heat recovery ventilator must be included as part of this system. Tables 9.32.3.7.A and 9.32.3.7.B of the Code may be used in limited circumstances to size the ductwork for a heat recovery ventilator system.

Ventilation Systems Coupled with Forced Air Heating Systems

Mechanical ventilation systems may be coupled to the forced air heating system of the dwelling unit or may be stand-alone as in the case of heat recovery ventilators (HRVs).

The forced air heating system may be used to distribute ventilation air. In Type II dwelling units, the mechanical ventilation system must include a heat recovery ventilator in order to provide balanced ventilation and not cause depressurization. Type I dwelling units need not be equipped with a heat recovery ventilator; fans alone can be used to meet the mechanical ventilation requirements. In these dwelling units, the distribution of ventilation air which is drawn into the building through the building envelope is distributed by the forced air heating system. In Type I dwelling units, a dedicated ventilation air intake need not be provided. Type I dwelling units are defined as those dwelling units with only direct vent or induced draft combustion appliances, only direct vent gas fireplaces and with no solid fuel-burning appliances (for instance wood fireplaces and wood stoves). Type I dwelling units must not contain combustion appliances that can spill combustion by-products at fan-induced pressures.

A manual switch must be provided to control the forced air heating system's circulation fan when it is coupled to the mechanical ventilation system. The switch must be installed adjacent to the ventilation fan switch. The switch must be identified with the words CIRCULATION FAN.

Energy Efficiency Requirements

Programmable thermostats are required to be installed in dwellings other than those with solid-fuel burning appliances, ground source heat pumps, or where the system has a heating capacity less than 2 kW or serves a single room. The thermostats must be capable of allowing for different temperatures for at least four time periods per day with two day-types. They must also include a manual override, and have a temperature range of 13°C in heating mode to 29°C in cooling mode.

Starting January 1, 2015, furnaces for dwelling units are required to be equipped with an electronically commutated motor.

Dwelling Unit Type Definitions

Type I

This category includes dwelling units with fuel-fired combustion appliances that are direct vented or mechanically vented induced draft and that contain no solid fuel-fired combustion appliances. Only direct vented fuel-fired fireplaces are permitted in dwelling units in this category.

Type II

All dwelling units with Type I characteristics and that contain solid fuel-fired appliances are defined as Type II.

Type III

This category includes all dwelling units that contain natural draft fuel-fired appliances or mechanically vented induced draft non-solid fuel-fired fireplaces with or without supplementary electric heating (e.g. in basements or bonus rooms). If the only natural draft appliance is solid-fuel fired, the dwelling unit may be categorized as Type II.

Type IV

All dwelling units that contain electric space heating are described by this category.

Protection Against Depressurization

The depressurization requirements below may be applied to systems that are designed and installed according to Article 9.32.3.8. of the Code.

When determining the need to provide make-up air that limits depressurization, consideration must be given to whether a solid fuel-fired combustion appliance is installed in the dwelling unit. Where a sub-floor depressurization system is installed to reduce the risk of radon ingress, make-up air need not be provided for mechanical exhaust equipment.

The presence of soil gases must be dealt with through competent design. Protection against depressurization in this case becomes a serious consideration. (See Chapter 2 Foundations).

Where a solid fuel-fired combustion appliance is installed a heat recovery ventilator must be installed which is designed to operate such that the flow of exhaust air does not exceed the flow of intake air as noted in the Article 9.32.3.11. of the Code.

Carbon Monoxide Alarm

A carbon monoxide alarm must be installed in dwelling units that contain fuel-fired combustion appliances and/or a storage garage (see Article 9.33.4.2. in the Code). The carbon monoxide alarm must conform to CAN/CSA 6.19, "Residential Carbon Monoxide Alarming Devices" or UL 2034 "Single and Multiple Station Carbon Monoxide Alarms". It is to be installed at the height that the manufacturer recommends, or on or near the ceiling if specific instructions are not available. The carbon monoxide alarm must be hard connected to an electrical circuit and shall have no disconnect switch between the overcurrent device and the alarm. It must be wired so that its activation engages all carbon monoxide alarms within the dwelling unit. The alarm from a required carbon monoxide alarm must be audible within all bedrooms when the intervening bedroom doors are closed where the detector is located adjacent to the bedrooms. Refer to Subsection 9.33.4. of the Code.

Fan Ratings

All Code required exhaust fans must be rated based on CAN/CSA-C260-M, "Rating the Performance of Residential Mechanical Ventilating Equipment" or HVI 916 "Airflow Test Procedure."

All fans which are used as part of the total ventilation capacity (except those of heat recovery ventilators) must have sound ratings that conform to Figure 11.8. Capacity ratings for all fans are to be based on a static pressure of 50, 25, or 7.5 Pa (0.007, 0.0036, or 0.001 psi) depending on whether the fan is installed with ductwork connected on both sides, one side, or neither side, respectively.

All Code required fans must be installed according to manufacturer's instructions. All mechanical ventilation devices must conform to CSA Standard C22.2 No.113-M, "Fans and Ventilators".

Ducts

Ducts in ventilation systems must conform to the same ducting requirements ducts in heating systems as detailed in Part 6 of the Code, except that exhaust ducts which serve only a bathroom or water closet room may be made of combustible material provided the ducting is reasonably airtight and constructed of a material impervious to water.

Ductwork must be permanently supported or clipped to prevent sagging, excessive movement or vibration. Ductwork connected to supply or exhaust fans must be airtight at its joints.

Exhaust ducts must not discharge air into heated or unheated enclosed spaces. Discharging exhaust air into attics or soffit spaces is not permitted. Where exhaust ducts pass through unheated space, they must be insulated to not less than RSI 0.5 (R 2.84).

Ducts carrying outdoor air that pass through heated space must be insulated to at least RSI 0.5 (R 2.84). If the duct has an exposed length of more than 3 m (9' 10"), the insulation levels specified in Figure 11.9 must be used.

Supply and return ducts are required to be sealed in accordance with SMACNA, "HVAC Duct Construction Standards – Metal and Flexible". Ducts that are located in unconditioned space must be sealed to Class A seal level, and supply ducts located in conditioned space must be sealed to Class C seal level.

Kitchen exhaust ducts must be provided with a filter at the intake or the entire duct must be accessible for cleaning. Range hood ductwork must be made of noncombustible material.

Fan Sound Rating

Exhaust Fan Application	**Maximum Sound Ratings, sones**	
	CAN/CSA-C260M	HVI 915
Principlal exhaust fan	2	2.5
Supplemental exhaust fans installed in bathrooms and water closet rooms, and their make-up air fans	2.5	3.5
Supplemental exhaust fans installed in kitchens and their make-up air fans	no rating required	no rating required

Figure 11.8
Sound Rating for Required Fans (9.32.3.9.)

Insulation of Ducts Carrying Outdoor Air

Outside Winter Design Temperature (1) as per Supplementary Standard SB-1 °C (°F)	**Minimum Thermal Resistance** RSI (R)
-7 to -11 (19 to 12)	0.5 (2.8)
-12 to -17 (10 to 1)	0.9 (5.1)
-18 to -24 (1 to -11)	1.2 (6.8)
-25 to -29 (-13 to -20)	1.4 (7.9)
-30 to -34 (-22 to -29)	1.8 (10.2)
-35 (-31) and colder	2.1 (11.9)

Notes
(1) The outside winter design temperatures shall be those listed for the January 2.5 percent values.

Figure 11.9
Insulation of Ducts Carrying Outdoor Air (9.32.3.10.)

Heat Recovery Ventilators

Heat recovery ventilators (HRVs) must be installed according to manufacturer's instructions, including start-up procedures, air balancing and air flow determination. The HRV and all condensate lines shall be installed in a space where the ambient temperature does not adversely effect operation of the system.

HRVs must be installed so that supply and exhaust flows are balanced. The smaller flow must never be less than 90% of the greater flow unless specifically permitted by the manufacturer of the HRV. Refer to balancing requirements when solid fuel appliances are installed. Where the HRV is installed with flows that are substantially out of balance, Part 6 of the Code should be used to design the mechanical ventilation system.

Where a heat recovery ventilator is connected to a forced air heating system, the supply side of the HRV must be connected directly to the return side of the furnace. Two or more HRVs must not be connected in parallel air flow to a common downstream supply duct or exhaust duct, unless specifically recommended by the manufacturer.

HRVs must be able to provide a minimum 55% sensible heat recovery efficiency when tested to the low temperature thermal and ventilation performance test method set out in CAN/CSA-C439, " Rating the Performance of Heat/Energy Recovery Ventilators" at a Station 1 test temperature of -25 °C (-13 °F) at an air flow not less than 30 L/s (64 cfm).

Condensation on fans and motors must be avoided where HRVs are installed in unheated spaces. In these installations, manufacturer's instructions must be carefully followed to ensure proper HRV operation.

Free flow of condensate must be provided in accordance with the manufacturer's instruction or by a minimum 12.5 mm (1/2") nominal diameter pipe pitched in the direction of flow and complete with a trap or condensate pump with sufficient capacity. The condensate line must not be adversely affected by low temperatures.

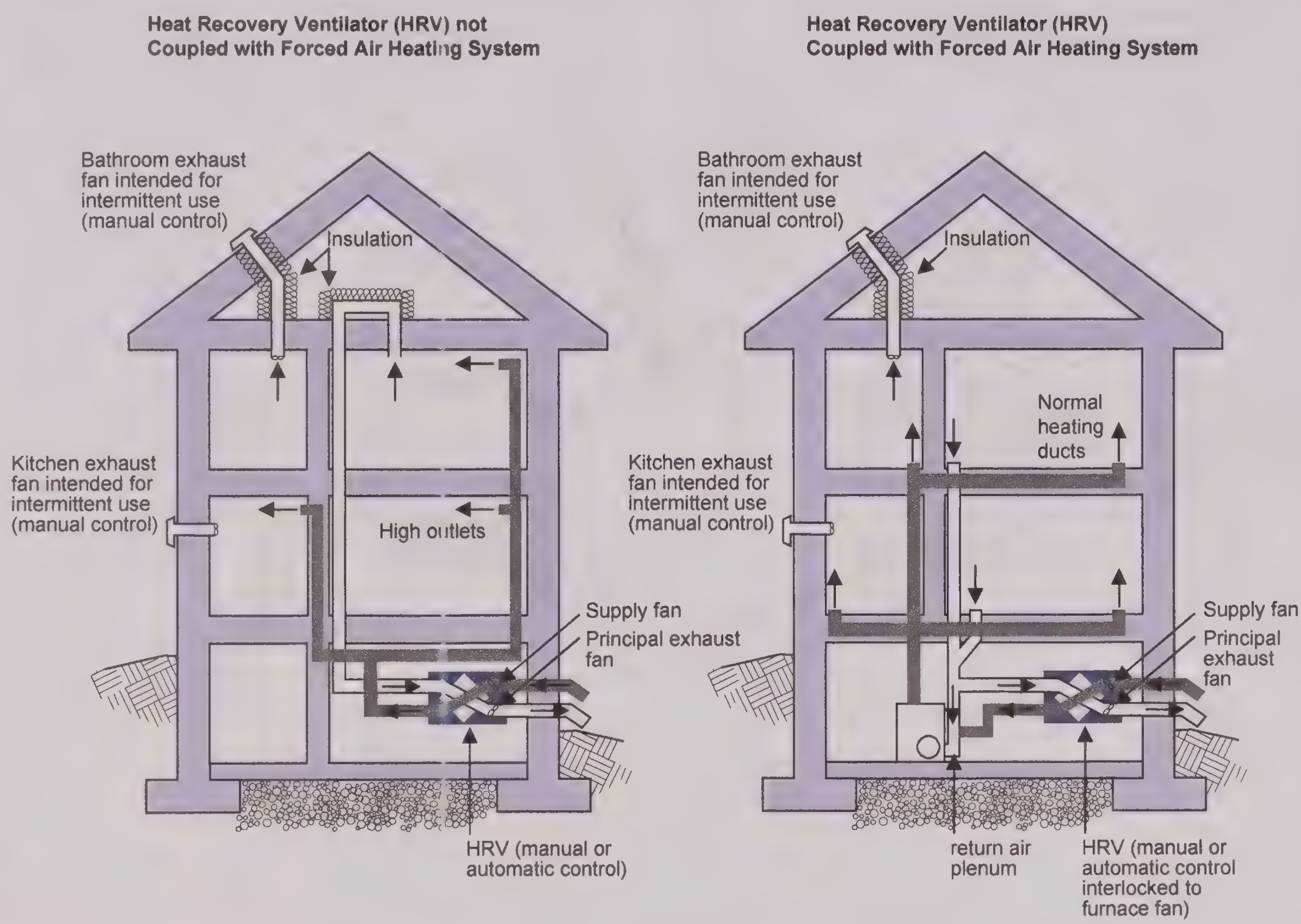


Figure 11.10
Configurations for Heat Recovery Ventilators (HRVs)

Point Exhaust Ventilation System - Forced Air Heating (Type I Houses Only)

This system includes one or more exhaust fans (usually in the kitchen (not a rangehood), a central location and/or bathrooms) having a combined capacity to meet the ventilation requirements of the house. To meet the Code, six issues must be considered:

- Select fans having a total capability of exhausting air based on the total room count as detailed in the Code.
- Use good quality, quiet fans meeting the noise requirements of the Code.
- Provide manual or automatic switches on fans.
- Air distribution fan should be used when ventilation fans are used.
- Distribution and ventilation fan switches must be appropriately labelled.
- Do not use any spillage susceptible appliances.

Applications:

- A builder may want to use this approach in houses with no spillage susceptible combustion appliances (naturally aspirating gas, oil with barometric dampers, and virtually all wood-burning appliances and fireplaces).

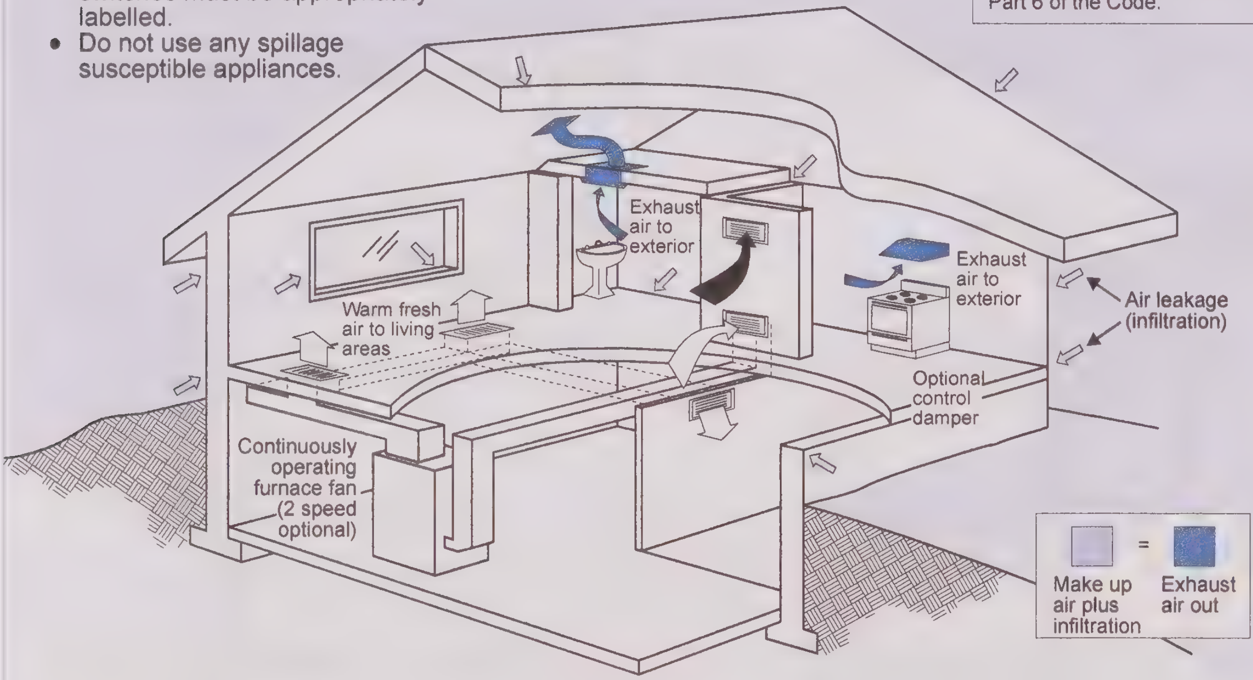
Advantages:

- Very little change from existing practice.
- Risk of wall/attic moisture problems is minimized.
- Wide selection of appropriate fans available on the market.

Drawbacks:

- The system must not be used where spillage susceptible combustion appliances are used.
- System can result in drafts and air infiltration possibly causing homeowner complaints.
- Risks of radon entry increased.
- The system can result in poor distribution of ventilation air. Air will enter by the easiest route leaving some rooms poorly vented.
- Increased heat loss when compared to heat recovery ventilation systems.

Note: High capacity air exhausting equipment can backdraft appliances which are generally resistant to backdrafting. Installation of this type of equipment should conform to Part 6 of the Code.



Balanced Ventilation System - Forced Air Heating (All House Types)

Balanced ventilation systems (eg. heat recovery ventilators) can provide high levels of indoor air quality while reducing the energy costs associated with heating ventilation air. A variety of heat recovery ventilators are currently available to the builder.

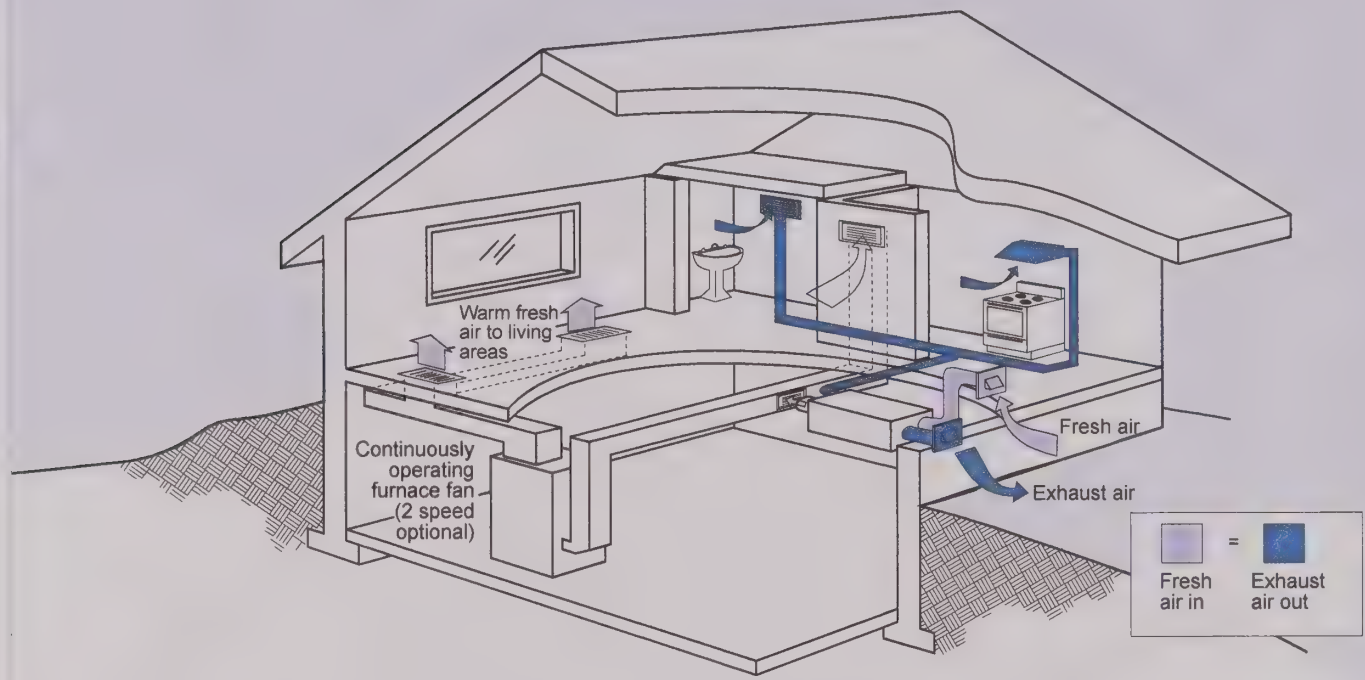
The supply side of the system can be easily integrated with a forced-air heating system with the furnace fan and ducting distributing the air to the living space.

Applications:
- Suitable for all house types but required in Type II houses.

Advantages:
- System has little influence on house pressures.
- Heat recovery tempers incoming air. Separate pre-heater may be needed only in coldest parts of the province.
- Proven technologies and independently tested systems are available "off the shelf".
- Heat recovery reduces cost of supplying ventilation air which may encourage use by occupants so there are fewer problems with condensation.

Drawbacks:
- Higher installed cost.
- System must be properly designed and installed.
- Higher system maintenance requirements:
  - filters and cores require regular cleaning
  - hoods should be inspected regularly for blockage.

Note: High capacity air exhausting equipment can backdraft appliances which are generally resistant to backdrafting. Installation of this type of equipment should conform to Part 6 of the Code.



Outdoor Intake and Exhaust Openings

Care must be taken to situate intake openings to avoid contamination of incoming ventilation air. Avoid locating intake openings where they may be subject to contamination from automobile exhausts, garbage, or exhaust openings including exhaust from adjacent buildings. Intake openings must be located no closer than 900 mm (2' 11") from sources of contamination, including gas vents or oil fill pipes. Figure 11.11 illustrates required distances and heights of intake and exhaust openings.

Intakes must be located at least 450 mm (17-3/4") from finished ground level or the local expected depth of snow accumulation, whichever is greater. They must be labelled for easy identification from the exterior of the dwelling unit. Screens or grilles must be installed to protect the opening from the entry of insects or animals. Where the screen or grille has a screen size of 6 mm (1/4") or less, it shall be removable for cleaning. The gross area of the air intake or exhaust outlet must be three times that of the duct served.

Exhaust openings must be located at least 100 mm (4") from finished ground level. Exhaust outlets, other than for HRVs must be equipped with backdraft dampers. A screen must be located at the building envelope to protect the opening from the entry of animals. Except for clothes dryers and where climatic conditions may require larger openings, exhaust outlets must be fitted with screens of mesh no larger than 15 mm (5/8").

All ventilation openings must be at least equal to the cross-sectional area of the duct served. All openings must be protected from precipitation by the use of louvres, weather cowls or other suitable protection, with all screens and grilles made of corrosion-resistant material.

Installation

Fans and heat recovery ventilators must be installed according to manufacturer's instructions for minimizing noise and vibration transmission. All dampers that are intended to regulate flow must be adjustable and accessible without requiring the removal of fans, motors or insulating materials and without the need for specialized tools. All ventilation equipment must be accessible for inspection, maintenance, repair, and cleaning.

Manufacturer's instructions must be followed carefully when installing ventilation equipment in unheated spaces to avoid condensation of moisture on fans and motors.

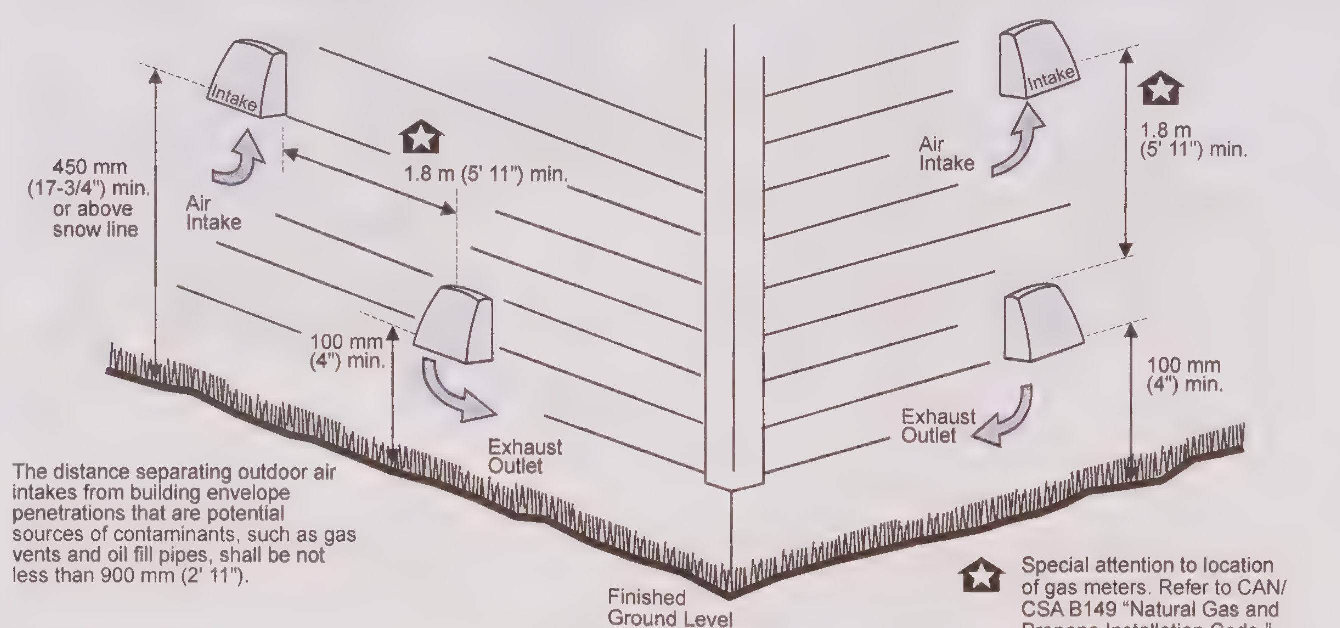


Figure 11.11
Air Intake and Exhaust Opening Locations
(9.32.3.12.)

12 PLUMBING AND ELECTRICAL FACILITIES

The plumbing and electrical systems of dwelling units are among the least understood yet most important systems of the building and for occupant convenience.

The construction, alteration, renewal or repair of plumbing systems must conform to Section 9.31. and Part 7 of the Code. This Guide, while providing an overview of selected plumbing requirements, is not a how-to manual on plumbing. A number of trade publications are available that address the intricacies of plumbing in detail.

Electrical facilities in housing are governed by the Ontario Electrical Safety Code. Once again, this Guide provides an overview of the Building Code's electrical requirements. It does not review the requirements of the Ontario Electrical Safety Code in any detail.

The intention of the plumbing and electrical facilities provisions of the Code is the safe and reliable distribution of water and electricity throughout the building. In addition, the Code provides for the removal of sewage and waste water from the building.

KEY POINTS

Plumbing systems in dwelling units must be designed and installed to fulfill the following functions:

- provide potable water (both heated and unheated) for washing, bathing, and laundry;
- discharge wastes to public or private sewage disposal systems; and
- be integrated into the structural framing of the dwelling unit.

Electrical Systems in dwelling units must be designed and installed to fulfill the following functions:

- ensure safe connections to utility services;
- provide lighting and access to outlets which maximize occupant safety and convenience; and
- meet the requirements of the Electrical Safety Authority.

PLUMBING FACILITIES

BUILDING CODE REFERENCES

DIVISION B

9.5.2.3.	Stud Wall Reinforcement
9.14.5.2.	Sump Pits
9.31.1.1.	Application
9.31.2.1.	General
9.31.2.2.	Corrosion Protection
9.31.2.3.	Grab Bars
9.31.3.2.	Required Connections
9.31.4.1.	Required Fixtures
9.31.4.2.	Laundry Fixtures
9.31.4.3.	Hot Water Supply
9.31.4.4.	Floor Drains
9.31.6.1.	Hot Water Temperature
12.3.1.4.	Hot Water Piping Insulation

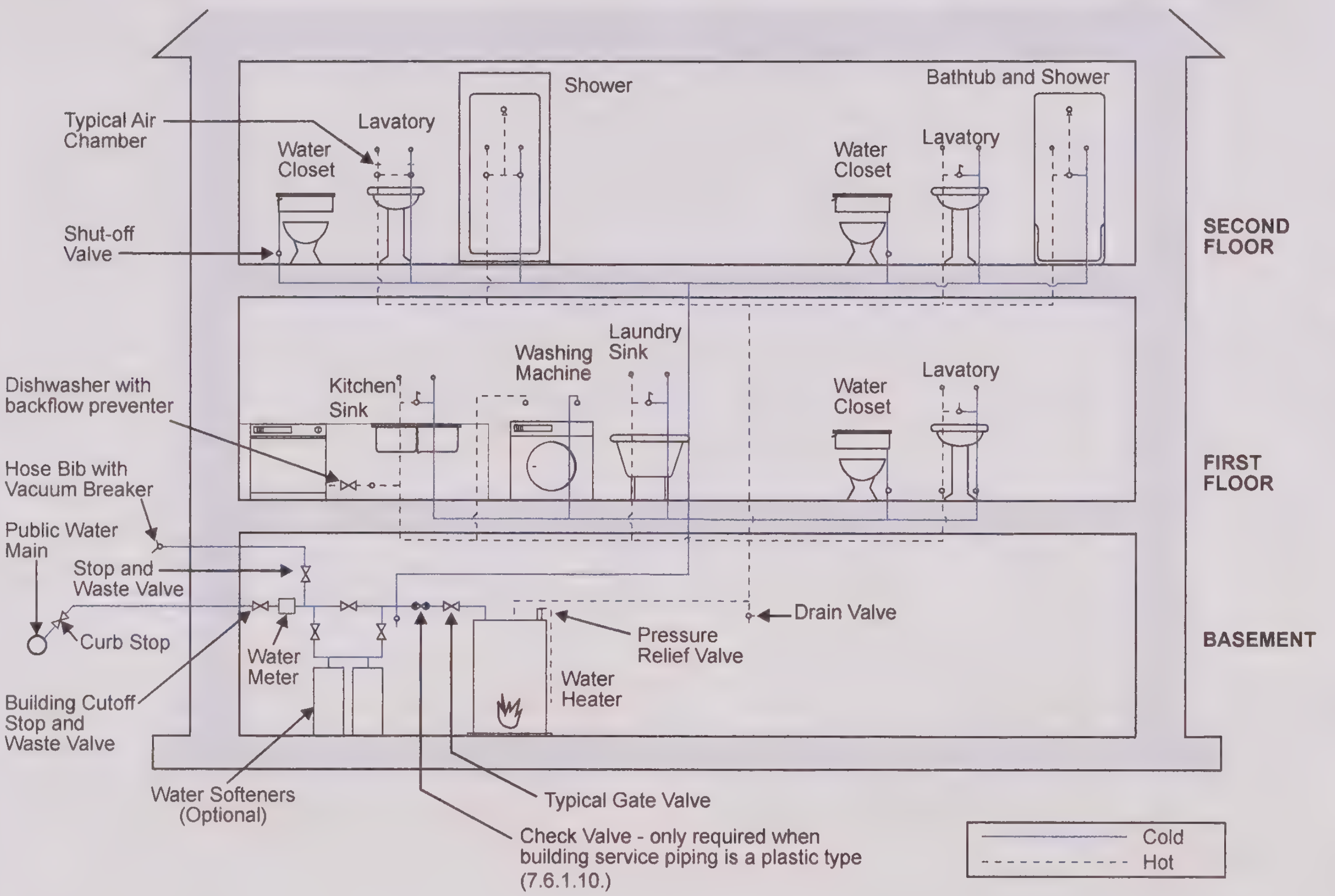
SUPPLEMENTARY STANDARD SB-12

2.1.1.11.	Drain Water Heat Recovery

The plumbing system includes the potable water supply system, the sanitary drainage and vent piping system, and the storm water drainage system. The general provisions of Part 9 of the Code include the protection of metal pipes that come into contact with corrosive material with a heavy coat of bitumen or other suitable coating or covering. Anchorage requirements for grab bars, where they are installed, are also prescribed in Article 9.5.2.3. of the Code for present or future use. These requirements are illustrated in Chapter 7.

Water Supply and Distribution

Potable water must be supplied to every dwelling unit from an approved public or community system where available. Dwelling units that have a piped water supply distribution system must have piping for hot and cold water connected to every kitchen sink, lavatory, bathtub, shower, slop sink and laundry area. Piping for cold water must be run to every water closet and hose bib. Figure 12.1 illustrates one approach to water supply piping.



Shut-off valves are required on every water closet at its water supply pipe. Shut-off valves to lavatories, sinks, showers and tub are not required by Part 7 of the Code but may be installed for convenience. All shut-off valves must be accessible. (7.6.1.3.)

If using plastic pipe, the pipe material must be identified and traced where it changes to copper. (7.6.1.3.(6).

Article 7.6.5.1. requires that the maximum temperature of hot water to fixtures in a dwelling, except to dishwashers or clothes washers, not exceed 49 °C (120 °F).

Article 7.6.5.2. of the Code requires all shower valves to be pressure balanced or thermostatic mixing valves.

Figure 12.1
Potable Water Supply Piping

(7.6.) (9.31.3.2.)

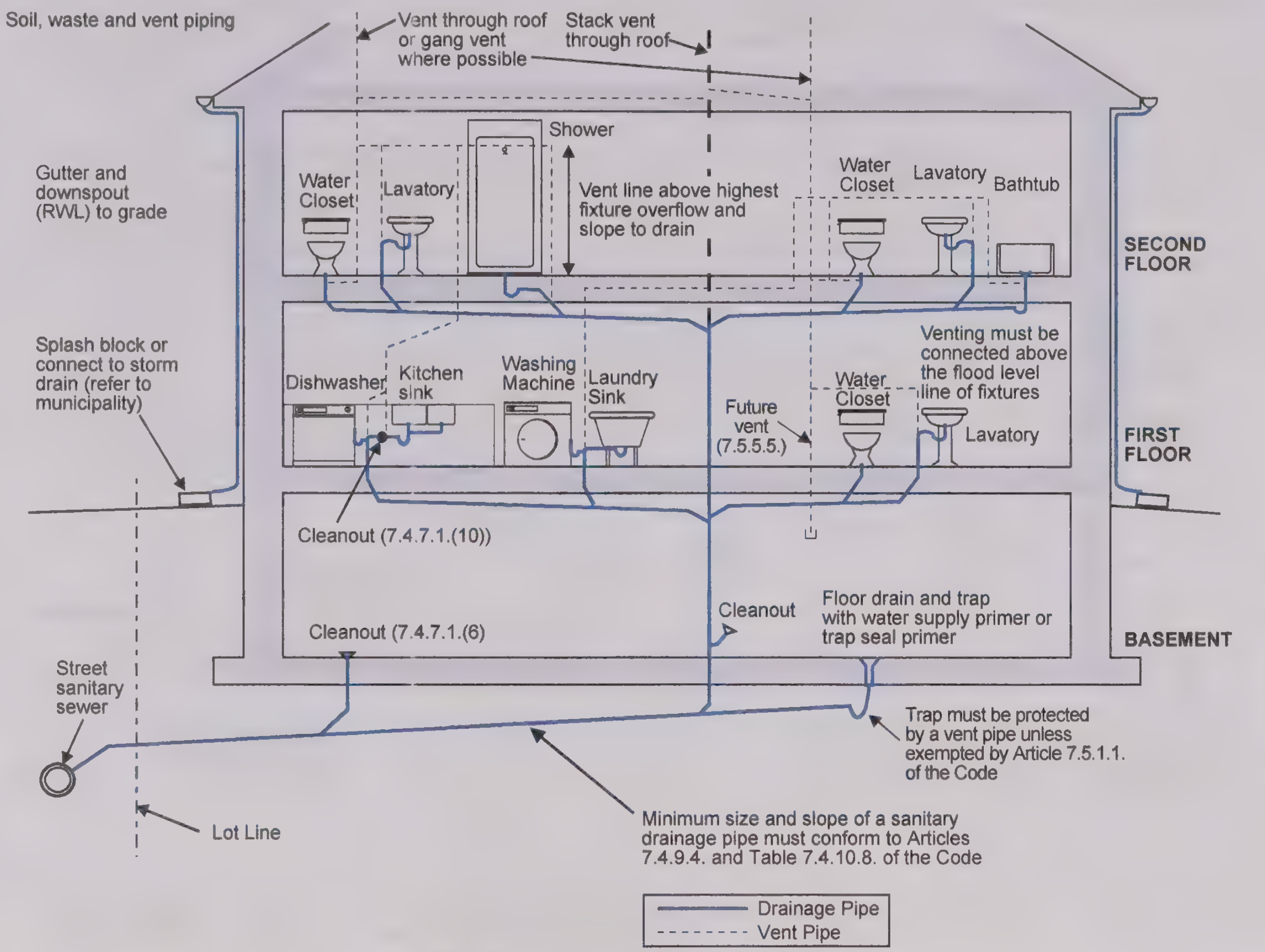


Figure 12.2
Public Sanitary Sewer

(9.31.)

Potable water systems must always be protected from backflow and possible contamination. This code requirement is extended to solar hot water heating systems that may be connected to a potable water supply as referenced in Code Article 7.6.2.5. Rainwater and greywater are permitted to be used for certain applications; refer to Part 7 of the Code for more information.

Polyethylene/Aluminum/Polyethylene Composite Pressure-Pipe systems may be used in a hot water system provided that it has a pressure rating of 690 kPa (100 psi) or greater at 82 °C (180 °F). The fittings used with this system must conform to the CAN/CSA Standard: B137-10 "Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene PEX-AL-PEX Composite Pressure-Pipe Systems". Refer to Part 7 of the Code for further requirements.

Sewage Disposal

Wastes from every plumbing fixture must be piped to the building sewer which must discharge into a public sewage system or into a private sewage disposal system where no public system exists.

Floor drains are required in basements of dwelling units. Figure 12.2 illustrates approaches to public sewage systems. The use of a sewage ejector to a public or private sewage system is depicted in Figure 12.3.

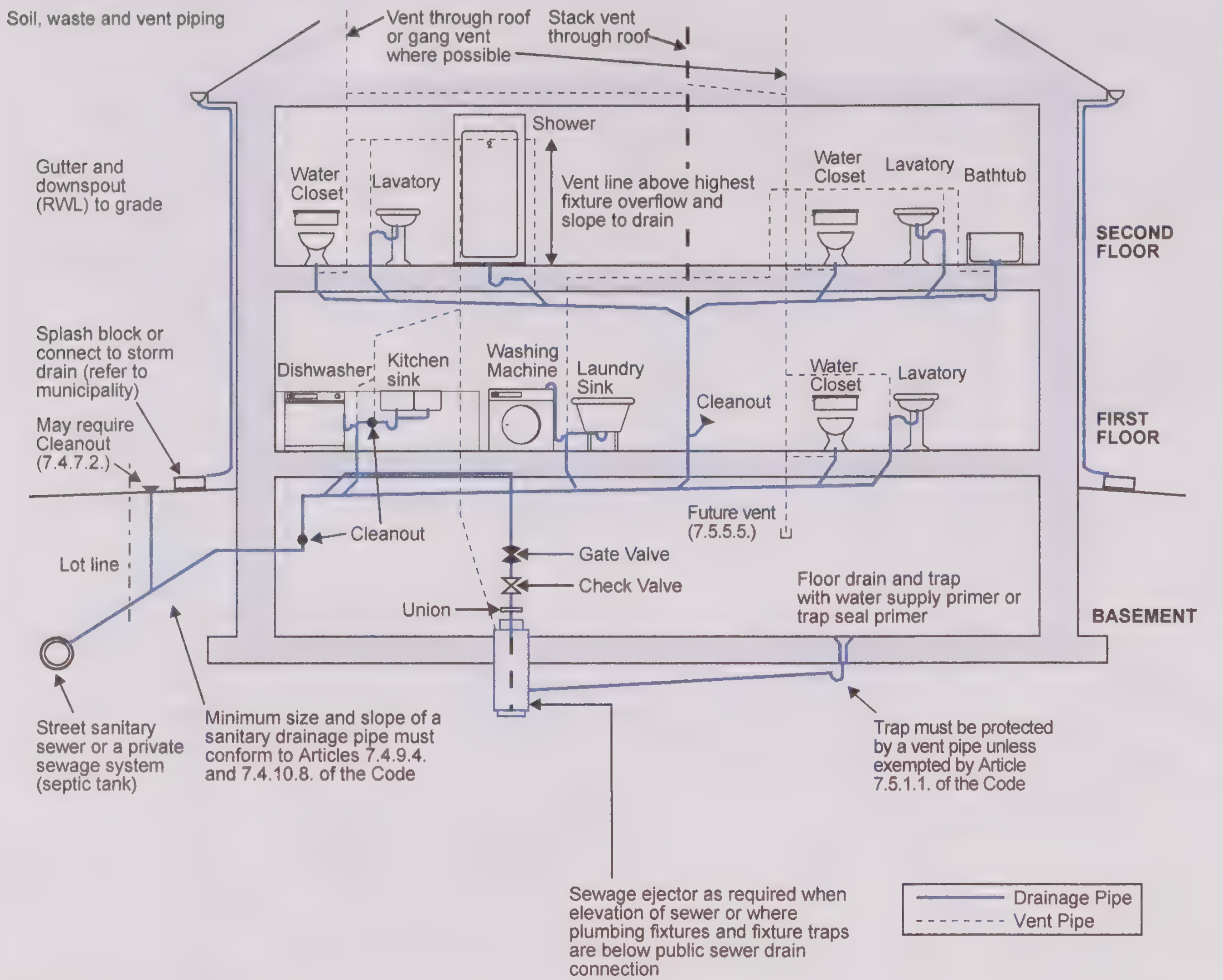


Figure 12.3
Public or Private Sewage System

(9.31.2.1.)

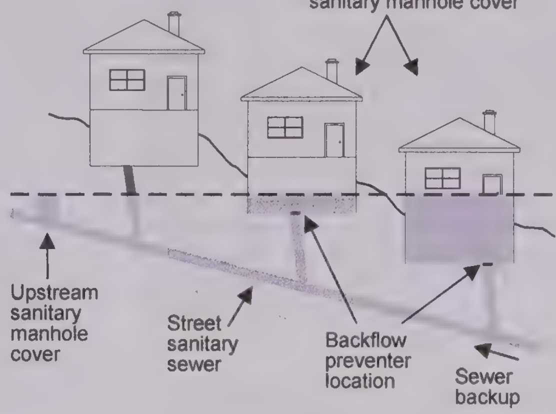
Better Building Note

Backflow Preventer

Basement flooding has increased in recent years. As a result of the unpredictability of extreme rainfall events and the water infiltration and inflow into sewer systems, sewer backup could happen. A major contributor to infiltration and inflow are foundation drains attached to the storm sewer, causing sewer backup and basement flooding.
Homeowners experience the loss of use of their home and damage to contents and belongings. Flood water containing raw sewage are also a significant health concern.

Properly installed and maintained backflow preventers can help to prevent sewer backup and basement flooding. Some municipalities may require backflow preventers.

See Part 7 of the Building Code for more information on backflow preventer requirements.



Required Facilities

All dwelling units must be provided with laundry facilities or a space for laundry facilities. In addition, where a piped water supply is available, all dwelling units must be provided with the following:

- a kitchen sink,
- a lavatory,
- a water closet or drainless composting toilet,
- a bathtub or shower stall, and
- a floor drain.

Vent pipes through the roof must be at least 75 mm (3") in diameter and must extend at least 150 mm (5-7/8") above the highest point of the roof. Cleanouts must be the same size as the piping they serve, and be accessible for service.

Where sumps are required to deal with water from foundation drains or weeping tiles, they must discharge to a public storm sewer, a drainage ditch or a dry well. Sumps must have a cover to prevent air movement and comply with Article 9.14.5.2. of the Code. The design, construction, operation and maintenance of sewage systems are addressed in Part 8 of the Code.

Service Water Heating Facilities

Hot water supply equipment must be installed to provide an adequate supply of service hot water with a temperature range from 45°C (113°F) to 60°C (140°F); electrical water heaters that store water are required to have a minimum storage temperature of 60°C (140°F). Part 7 of the Code specifies the maximum temperature of hot water at fixtures to be not more than 49°C (120°F), except for dishwashers and clothes washers. Thermostatic mixing values can be used to limit this temperature at the fixture. Refer to Article 7.6.5.1. of the Code.

Chapter 11 of this Guide identifies the specific requirements that govern domestic hot water systems.

The first 2.5 m (8'-2") of pipe from a hot water outlet of a hot water storage tank must be insulated to a thermal resistance of not less than RSI 0.62 (R 3.5), unless the tank serves a recirculating system. The inlet pipe between the heat trap and storage tank must also be insulated to RSI 0.62 (R 3.5).

Drain Water Heat Recovery

Drain water heat recovery (DWHR) units, where installed, must conform to CSA B55.2, "Drain Water Heat Recovery Units" with a minimum efficiency of 36% as determined by CSA B55.1, "Test Method for Measuring Efficiency and Pressure Loss of Drain Water Heat Recovery Units".

The installation of DWHR units for SB-12 trade-offs must meet the following requirements:

- be connected to all showers, or at least two showers where there are more than two,
- be installed vertically (not more than 5° from plumb),
- be installed with the cold water inlet at the bottom on the unit,
- be installed downstream of a water softener,
- be installed in the conditioned space, or the warm side of the dew point in an assembly.

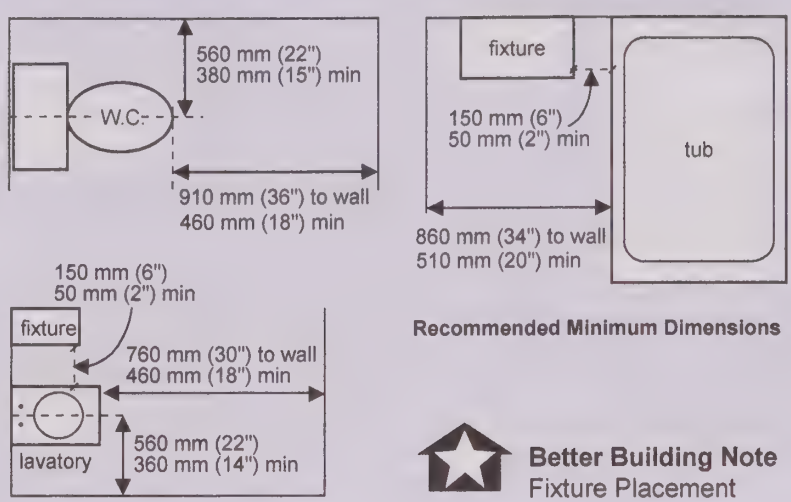
Higher efficiency DWHR units may be installed as part of the Supplementary Standard SB-12 envelope trade-offs. Refer to Chapter 13 for more information.

Bathroom and Water Closet Recommended Configurations

A bathroom, water closet room or laundry area above grade must have a minimum height of 2.1 m (6' 11") in any area where a person would normally be in a standing position. As well, an enclosed space of sufficient size must be provided to accommodate a water closet, lavatory and bathtub or shower stall. Minimum clearances between fixtures and other obstructions are important. There should be sufficient space for toweling off, dressing, grooming, and other activities.

One, two and three wall bathroom configurations offer a variety of planning solutions. Several alternatives are provided in the following illustrations.

The single wall layout has bathroom fixtures arranged along a single wall. It is often used where space is limited. Although it may not efficiently use the available floor space, it requires the fewest pipe fittings. A two-wall layout requires slightly more plumbing, but offers more floor area and storage space around the lavatory where they are needed. A three-wall layout requires more complicated plumbing and larger bathroom space, but offers the most flexibility in laying out the bathroom.



Recommended Minimum Dimensions

Better Building Note
Fixture Placement

Better Building Note
Structural Concerns

Structural members must be designed to support the loads from heavy plumbing fixtures such as hot tubs, etc. The builder must ensure structural members are not weakened by the installation of pipes and fixtures.

Design according to Part 4 of the Code will often be required.

Looking Back

For future grab bar installation and stud wall reinforcement, see Chapter 7 Wall Systems.

For requirements for domestic hot water systems, see Chapter 11 Mechanical Systems.

ELECTRICAL FACILITIES

BUILDING CODE REFERENCES

DIVISION B

9.1.1.5.	Proximity to Existing Above Ground Electrical Conductors
9.34.1.2.	Required Facilities
9.34.1.4.	Recessed Lighting Fixtures
9.34.2.1.	Lighting of Entrances
9.34.2.2.	Outlets in Dwelling Units
9.34.2.3.	Stairways
9.34.2.4.	Basements
9.34.2.5.	Storage Rooms
9.34.2.6.	Garages and Carports
12.3.1.6.	Energy Supply for Kitchen and Laundry Facilities After December 31, 2014

Electrical facilities in dwelling units are governed by the requirements of the Ontario Electrical Safety Code. Permits for electrical installations are issued by the Electrical Safety Authority which also performs mandatory inspections.

The Electrical Safety Code contains additional requirements beyond those cited in the Building Code. Licensed electrical contractors are normally hired for the installation of electrical facilities. Contact the Electrical Safety Authority for more information.

Starting on January 1, 2015, laundry and kitchen spaces must be provided with an electrical outlet, natural gas line, or propane line to supply energy to cooking and laundry appliances.

Lighting Outlets

An exterior lighting outlet with fixture controlled by a wall switch located within the building must be provided at every entrance. In addition, a lighting outlet with fixture controlled by a wall switch must be provided in kitchens, bedrooms, living rooms, utility rooms, laundry rooms, dining rooms, bathrooms, water closet rooms, storage rooms, vestibules and hallways. Fixtures can be omitted in bedrooms and living rooms provided these rooms have a receptacle controlled by a wall switch.

In addition, a light outlet and fixture must be provided for an attached, built-in or detached garage or carport. These outlets must be controlled by a wall switch near the doorway where the fixture is ceiling mounted above an area normally occupied by a parked car; otherwise a switched lamp holder may be used.

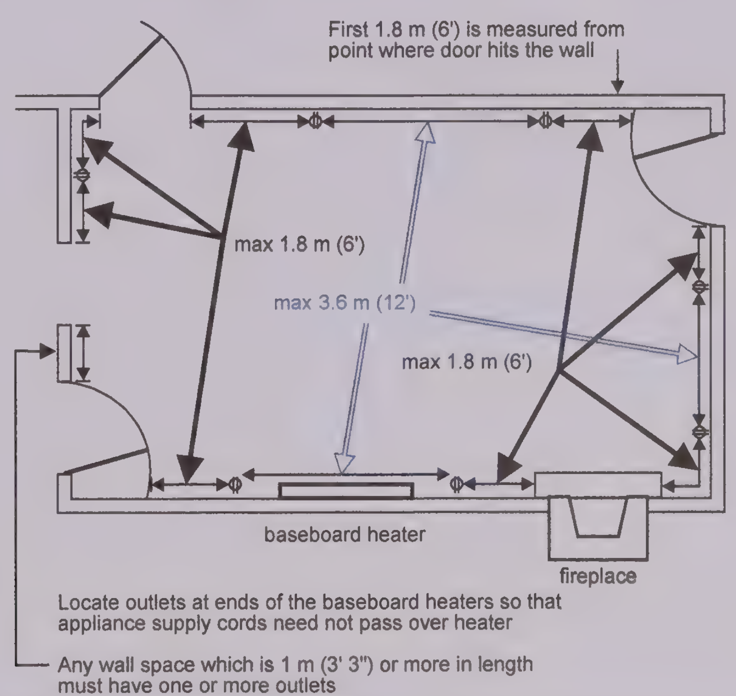
All stairways must be provided with a light. Three-way wall switches located at the head and foot of every stairway must be provided to control the light for stairways with 4 or more risers.

Stairway lighting for basements that do not contain finished space nor lead to an outside entrance or built-in garage and which serve not more than one dwelling unit may be controlled by a single switch located at the head of stairs. As well, a lighting outlet with fixture must be provided for each 30 m^2 (323 ft^2) of floor area in unfinished basements.

Recessed lighting fixtures must not be located in insulated ceilings unless the fixtures are designed for this type of installation. Pot lights for instance must be installed with their appropriate housing to minimize overheating and preserve air barrier continuity.

Where a carport is illuminated by a light at the entrance to a dwelling unit, additional carport lighting is not required.

Recommendations: Locating Electrical Outlets



13 ENERGY EFFICIENCY, AIR AND VAPOUR BARRIERS

Air barriers, vapour barriers, and thermal insulation are the main elements in buildings designed to control the flow of heat, air and water vapour. There are a number of methods and materials permitted by the Code for each control function. In some instances a single material is able to satisfy the requirements of the Code while in others a combination of materials can be used.

In this Chapter, Code requirements for energy efficiency, including insulation, air barriers, and vapour barriers, will be presented. These requirements can be found in Supplementary Standard SB-12 in addition to those in Part 9 and Part 12. This Chapter also highlights the energy efficiency requirements that will become mandatory on January 1, 2017.

At the design stage, the various ways to insulate the envelope should be evaluated carefully. There may be a number of ways to insulate an envelope component. Each way requires different materials, trades, construction sequencing and cost. The ease of construction will invariably be dictated by these choices. This is particularly true for exterior walls which typically represent the largest component of the building envelope.

The choice of interior insulation versus exterior for basements, glass fibre versus spray foam, insulated sheathing versus wood-based sheathing, for instance, will need to be carefully considered. Each choice will not only dictate how the assembly controls the movement of heat but will also affect the choice of other components intended to control air and water vapour flow.

KEY POINTS

Insulation, air barriers, and vapour barriers must be designed and installed to fulfill the following functions:

- provide thermal insulation as required for the appropriate region of the province;
- restrict the flow of house air into, and out of, the building envelope;
- restrict the passage of water vapour by diffusion into the building envelope;
- allow moisture within the building envelope to escape to the exterior; and
- highlight new prescriptive solutions for achieving acceptable air leakage rates and energy efficiency levels.

AIR BARRIERS

BUILDING CODE REFERENCES

DIVISION B
9.25.3.1. Required Barrier to Air Leakage
9.25.3.2. Air Barrier System Properties
9.25.3.3. Continuity of the Air Barrier System

Air barriers installed to form part of the building envelope assembly are intended to reduce the leakage of moisture laden air into exterior assemblies where it may condense and lead to problems. Air barriers also preserve the thermal resistance effectiveness of air permeable insulation materials. This section deals with the Code requirements for air barrier materials and their installation.

GENERAL

The construction of all wall, ceiling and floor assemblies which are thermally insulated must provide a continuous barrier to the leakage of air from the interior of the building into wall, ceiling, floor or roof spaces and also exterior to interior air movement. Figure 13.1 illustrates typical locations that should be carefully considered when designing and installing the air barrier.

MATERIALS

Materials used to provide air barrier protection must be capable of effectively preventing air movement under differential air pressure due to stack effect, the operation of mechanical systems and wind. All air barrier materials must have an air leakage characteristic not greater than 0.02 L/(s•m^2) when measured at 75 Pa (0.011 psi). Due to the reversals of air pressure across building envelopes, it is especially important to select materials with adequate resistance to long term fatigue.

Polyethylene sheeting may be used to provide both air barrier and vapour barrier protection provided it conforms to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction." Ensure that this standard identification mark appears on the polyethylene sheet before installation.

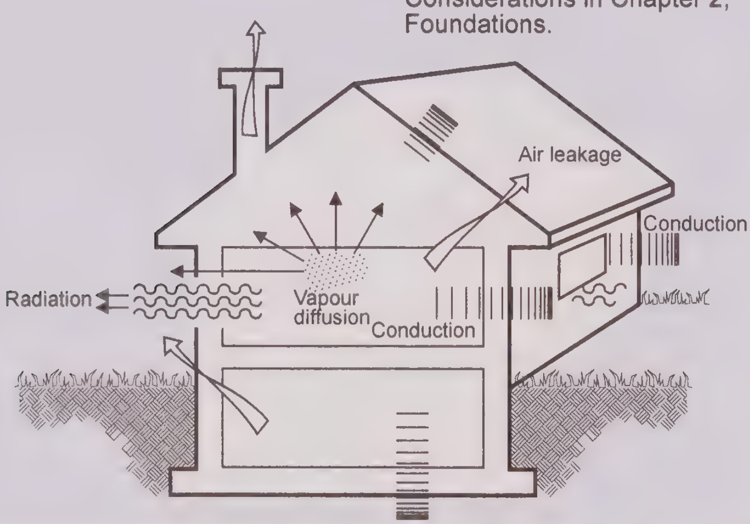
Environmental Separator Considerations

Comfortable conditions inside the dwelling are maintained by separating the interior from the outdoors.

The building envelope must also be able to provide separation of the interior and exterior environments while fulfilling other functions such as structural integrity and durability.

Environmental separation is provided to control heat flow (by radiation, conduction and convection), air leakage and moisture migration. It is important to ensure that adequate levels of thermal insulation, a continuous air barrier and vapour barrier are provided throughout the building envelope. Design of heating and cooling is directed by the climate and requires consideration of summertime condensation.

For the control of below grade moisture migration, see Moisture Considerations in Chapter 2, Foundations.



Installation

Joints in the air barrier system must be completely sealed where air-impermeable panel type materials are installed, and sealed with a compatible material, or lapped at least 100 mm (4") and mechanically clamped or stapled where flexible sheet material is installed. Where flexible sheet material is used, and it is not supported by an interior finish, its continuity must be maintained by sealing its joints. Examples of these locations include behind a bath tub, shower enclosure or fireplace.

The location of air barriers with low water vapour permeability on the cold side of insulated assemblies must be avoided. Where this location is being considered, the requirements for such air barriers must be checked in accordance with the criteria set out in Subsection 9.25.3. of the Code.

Air barriers must be continuous across all interior/exterior floor, wall and ceiling intersections and shall extend throughout the basement. All penetrations through exterior assemblies such as doors, windows, sump pits, electrical wiring, electrical boxes or piping must be sealed to maintain a continuous air barrier. Where the foundation wall and floor slab are used as an air barrier, they must be sealed at all joints, intersections and penetrations.

In some situations, polyethlyene that is either part of an insulation blanket system or insulation frame wall system is used as the air/vapour barrier. In these cases, the poly air/vapour barrier must be sealed to the slab air barrier at the bottom and the air barrier which seals the floor header at the top.

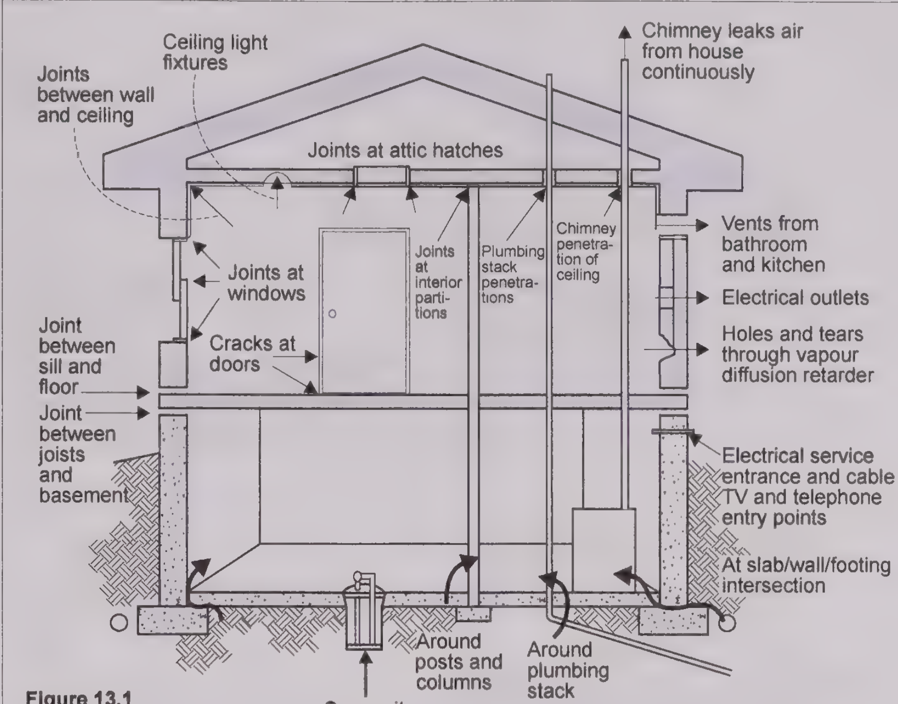


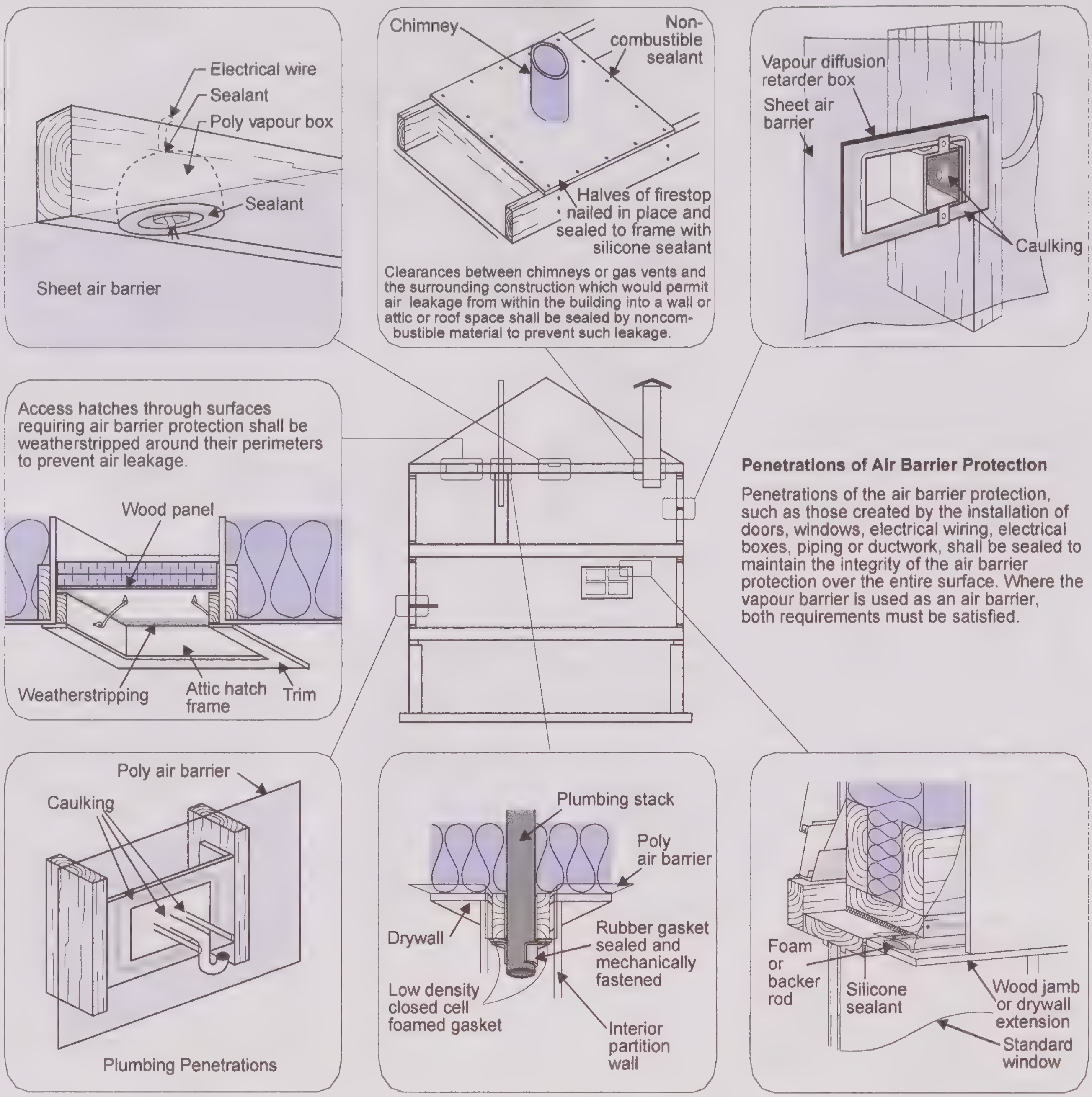
Figure 13.1
Air Leakage

Access hatches through the insulated building envelope must be weatherstripped to prevent air leakage. Joints in any ductwork passing through unheated spaces must be sealed airtight.

Figures 13.2 and 13.3 depict acceptable air barrier installation details at intersections and penetrations respectively. Appendix A of the Code provides the relative air permeability of various materials (shown in Figure 13.10). See Figures 13.4 to 13.7 for additional air sealing details.

Clearances between chimneys and gas vents penetrating assemblies requiring air barrier protection must be sealed with noncombustible material. It is extremely important to verify that only chimneys and gas vents approved for this type of installation are specified, as warranties and fire insurance may otherwise be voided.

Where hollow core masonry walls penetrate the ceiling, the cores must be sealed at or near the ceiling to prevent air from leaking through the cores into the attic or roof space. Sealing may consist of either solid masonry capping or flashing material extending across the full width of the masonry and along the full length of the penetration.



Penetrations of Air Barrier Protection

Penetrations of the air barrier protection, such as those created by the installation of doors, windows, electrical wiring, electrical boxes, piping or ductwork, shall be sealed to maintain the integrity of the air barrier protection over the entire surface. Where the vapour barrier is used as an air barrier, both requirements must be satisfied.

Figure 13.2
Air Sealing Penetrations

(9.25.3.3.)

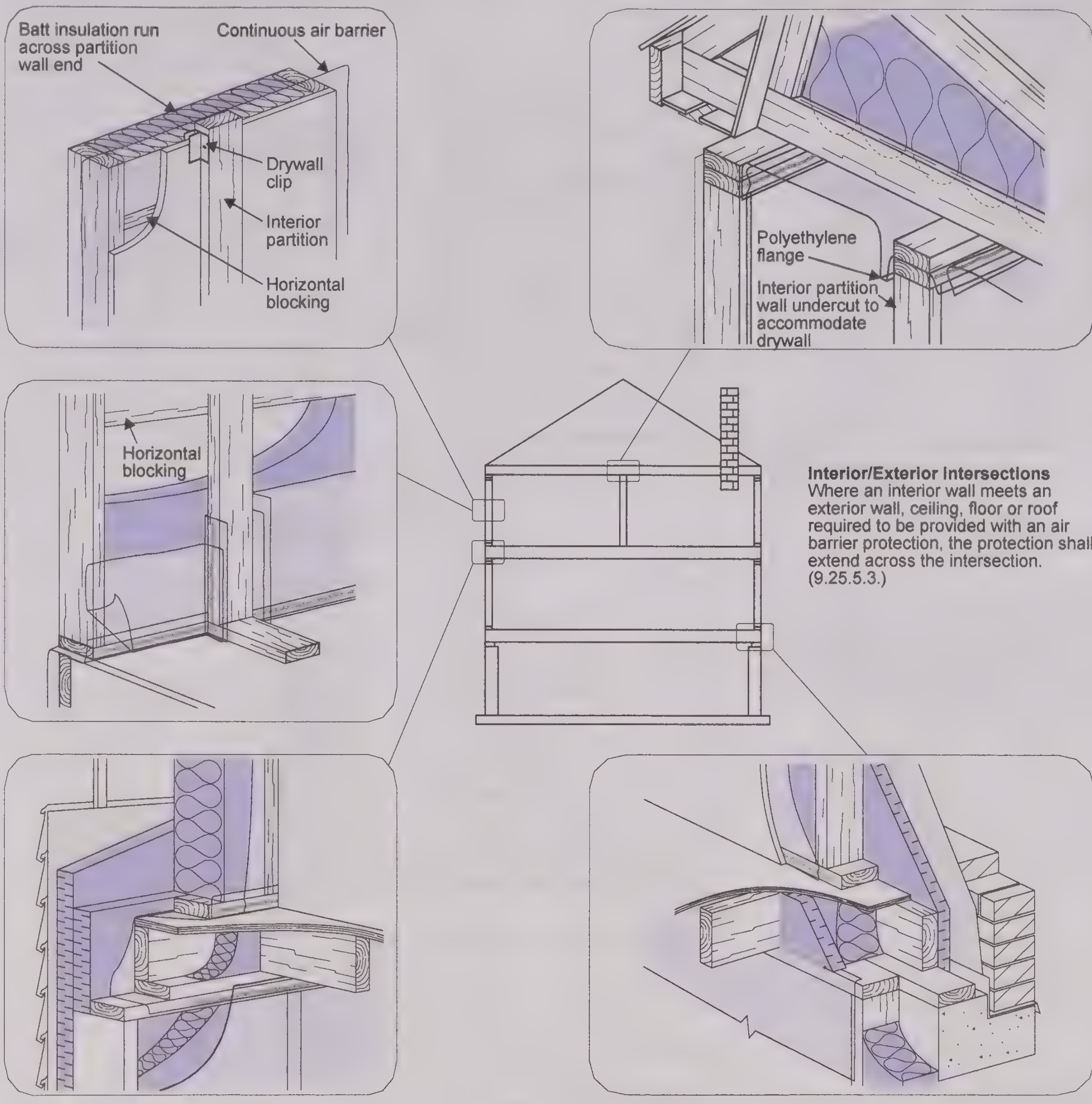


Figure 13.3
Air Sealing Intersections

(9.25.3.3.)

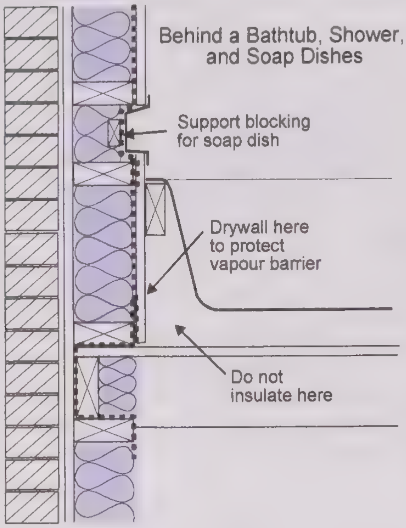


Figure 13.4
Air Barrier Requirements (9.25.3.)

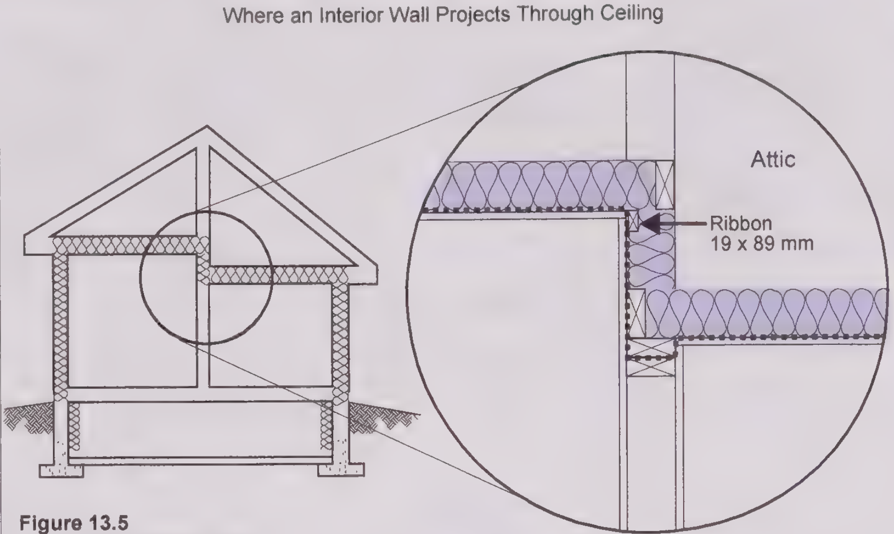


Figure 13.5
Air Barrier Requirements (9.25.3.)

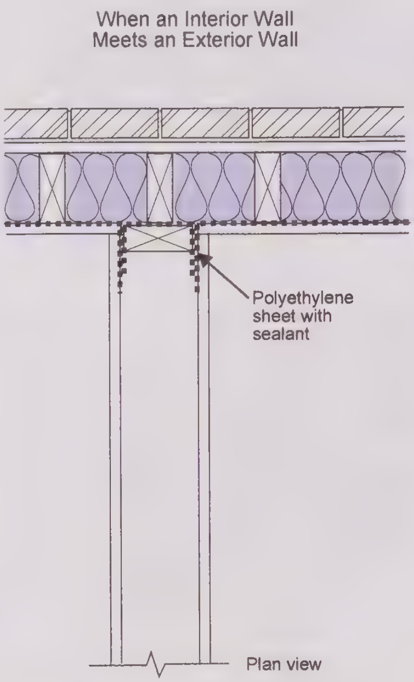


Figure 13.6
Air Barrier Requirements (9.25.3.)

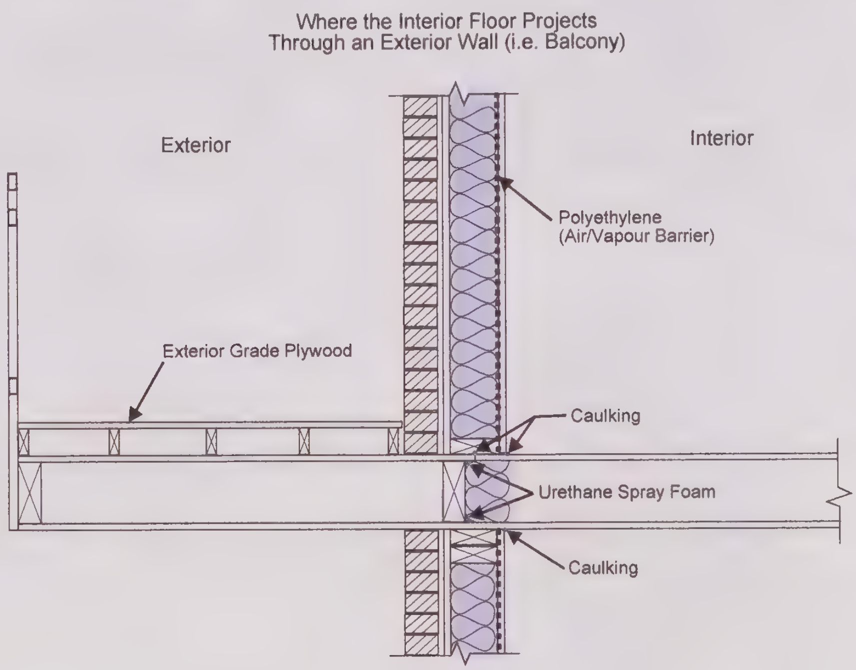
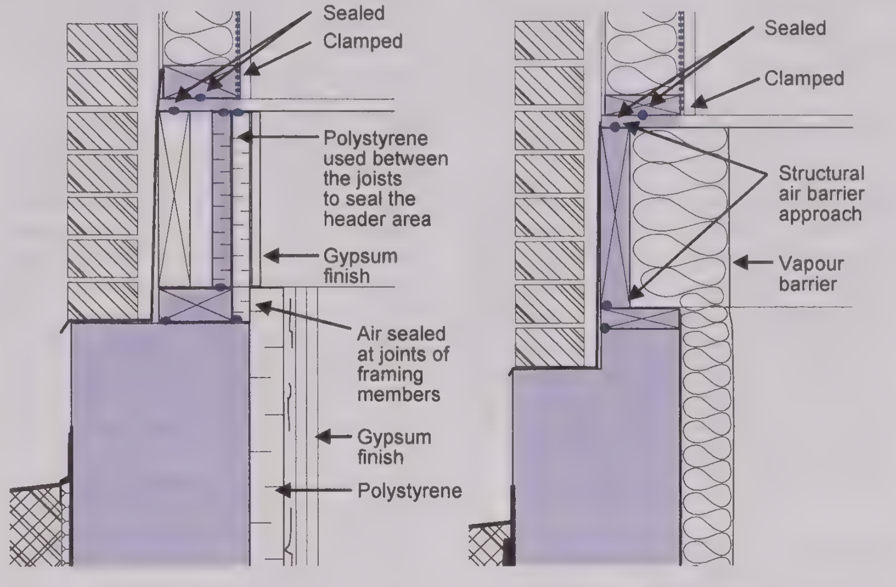


Figure 13.7
Air Barrier Requirements (9.25.3.)

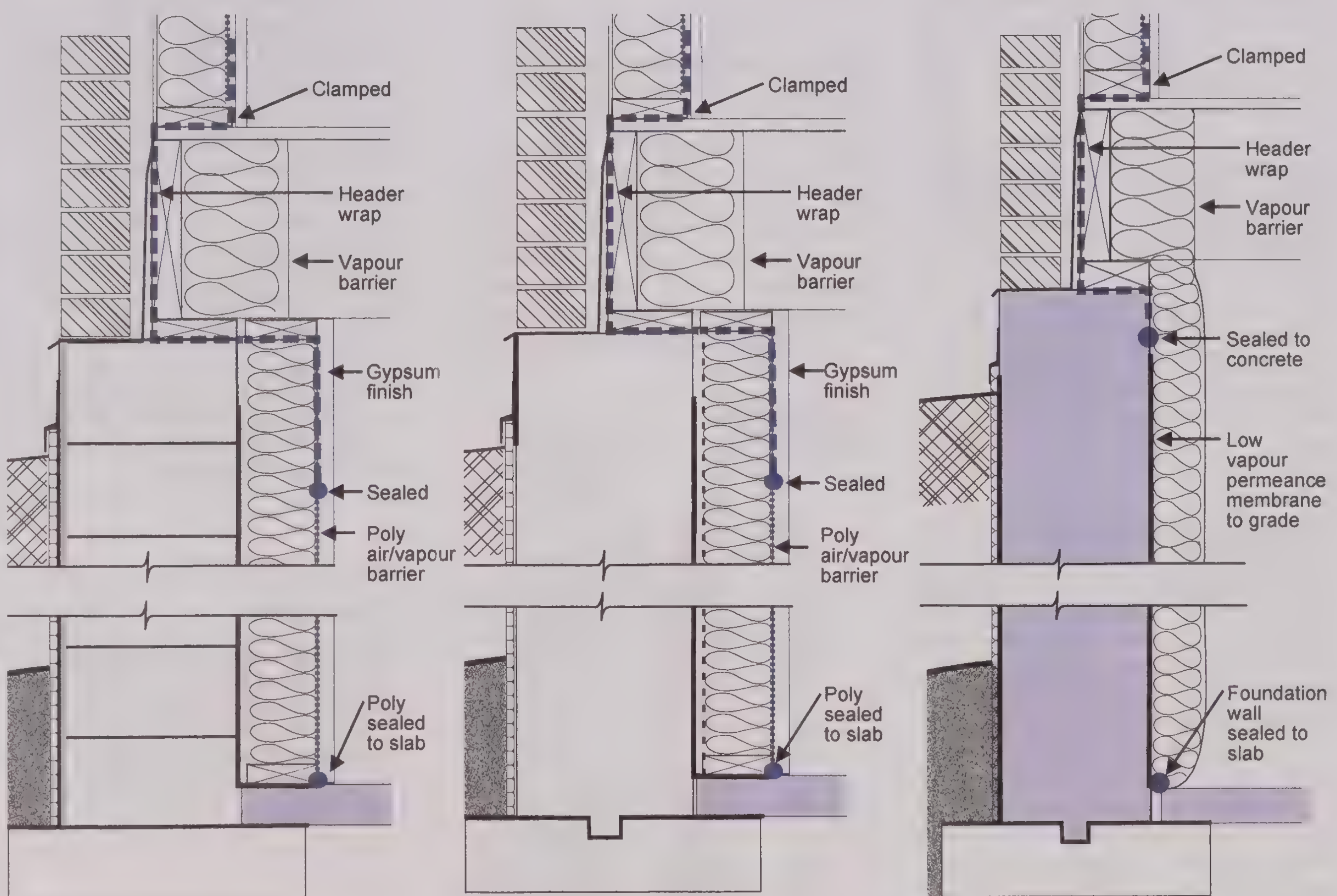
Header Systems

Header wraps are often used to provide continuity at the junction between wood framed floor systems and the concrete foundation wall. Other systems for sealing this area include creating a structural air barrier by caulking the joints between framing members and the top of the foundation wall. Rigid polystyrene foam placed vertically between the foundation wall and the subfloor and caulked at both ends is a very popular approach in the Atlantic provinces. Finally, spray foam insulation applied to the header cavity between the top of the foundation wall and subfloor has also been proven to provide a suitable level of air tightness. These four systems are among the many different approaches used by builders across the nation. Corners are always a challenge and require special care to ensure air barrier continuity. Header wraps, for example should overlap a minimum of 100 mm (4 inches) at the corner and be continuously sealed near the end of the each piece.



Interior polystyreme with strapping

Interior blanket/ exterior polystyrene combination



Unit masonry wall with frame and fiberglass batts

Interior frame wall with batt infill

Blanket system

Figure 13.8
Header Systems

Note: air barriers are highlighted blue

(9.25.3.)

VAPOUR BARRIERS

BUILDING CODE REFERENCES

DIVISION B
9.25.4.1. Required Barrier to Vapour Diffusion
9.25.4.2. Vapour Barrier Materials
9.25.4.3. Installation of Vapour Barriers

Vapour barriers are intended to prevent the diffusion of water vapour through insulated building assemblies. The amount of moisture penetrating insulated building assemblies by diffusion is significantly less than that by air leakage. Where separate materials serve the functions of air barrier and vapour barrier, the continuity of the vapour barrier is far less critical.

General

All thermally insulated wall, ceiling and floor assemblies must be provided with a barrier to diffuse water vapour from the interior into wall, floor, attic or roof spaces. All vapour barriers must have an initial permeance not greater than 60 ng/(Pa•s•m²) (1.04 PERM INS), measured in accordance with ASTM E96 "Water Vapor Transmission of Materials". Insulation is permitted to be used as a vapour barrier provided it meets the above stated permeance requirements and is sufficiently close to the warm side of the assembly to prevent condensation. Where the intended use of the interior space will result in high moisture generation, the assemblies must be designed to Part 5 of the Code.

Materials

Standards governing vapour barrier materials are outlined in Article 9.25.4.2. of the Code. Membrane type vapour barriers must conform to CAN/CGSB-51.33-M, "Vapour Barrier, Sheet, Excluding Polyethylene, for Use in Building Construction". Permeance of coatings applied to gypsum board to function as the vapour barrier is determined in accordance with CAN/CGSB-1.501-M, "Method for Permeance of Coated Wallboard". If polyethylene is used as a vapour barrier in this application, it must conform to CAN/CGSB-51.34-M "Vapour Barrier, Polyethylene Sheet for Use in Building Construction". See Figure 13.10.

Installation

Vapour barriers must normally be installed on the warm side of the dew point to protect all surfaces of thermally insulated wall, ceiling and floor assemblies. Vapour barriers may be installed between layers of insulation provided the surface temperature of the vapour barrier within the insulated assembly can be shown not to support condensation of the indoor air when the outside temperature is equal to the winter design temperature. See Figure 13.9.

Some insulation materials are not affected by humidity. Vapour barriers do not have to be installed when the vapour permeance of thermal insulation is less than that required for vapour barriers.

Low Air and Vapour Permeable Sheathings

Exterior sheathings that are of a low permeability to both air and water vapour must be carefully located within the envelope to avoid condensation on the sheathing. Figure 13.11 describes the procedure that must be used to check whether the location of sheathing is permitted with low vapour and air permeance.

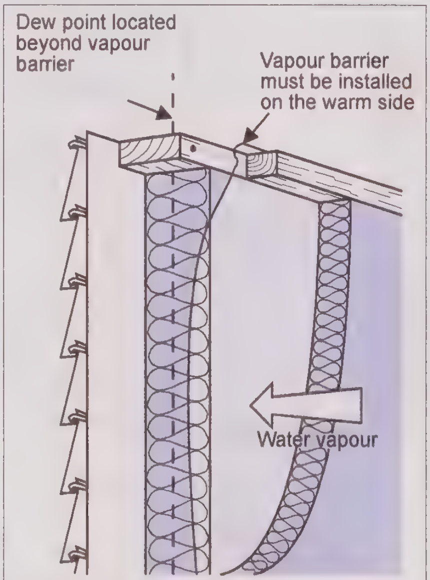


Figure 13.9
Recessed Vapour Barrier (9.25.4.3.)

Air Barriers vs. Vapour Barriers

Air barriers should not be confused with vapour barriers. This distinction is usually ignored when polyethylene is used as both an air and vapour barrier. But when the air barrier and vapour barrier consist of two separate materials, it is important to distinguish their requirements.

Air barriers must be continuous to prevent air leakage. Any holes or gaps will lead to air leaks and as a result, potential condensation. Aside from carrying moisture, air leaking from inside the building to the outdoors also carries heat with it. Mold, decay and high heating costs are the potential side effects of uncontrolled air leakage in today's well insulated building envelopes.

Vapour barriers protect the building envelope from the diffusion of water vapour. Where a separate air barrier is used, the vapour barrier need not be tight to the passage of air. In other words, small holes in the vapour barrier are acceptable provided the vapour barrier covers as much of the surface it is intended to protect but is practically possible. Vapour barriers must always be installed on the warm side of insulation. Air barriers may be located anywhere within the building assembly. Of course, if the air barrier and the vapour barrier are the same material then all of the rules for both apply when the material is installed.

Sealants

Sealants should be carefully selected to ensure compatibility with the materials being sealed. Non-hardening acoustical sealants have been used successfully to seal polyethylene air barriers in the past.

Air and Vapour Permeance Values

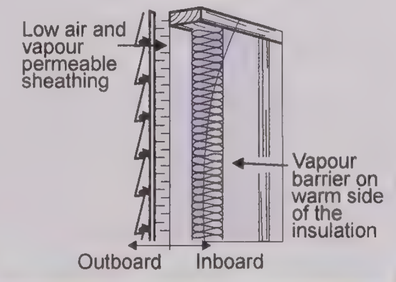
MATERIAL	Air Leakage Characteristic, s•m² at 75 Pa	Water Vapour Permeance ng/Pa•m²•s
Sheet and panel-type materials		
12.7 mm gypsum board	0.02	2600
• painted (1 coat primer)	negligible	1300
• painted (1 coat primer + 2 coats latex paint)	negligible	180
12.7 mm foil-backed gypsum board	negligible	negligible
12.7 mm gypsum board sheathing	0.009	1373
6.4 mm plywood	0.0084	23-74
11 mm oriented strandboard	0.0108	44 (range)
12.5 mm cement board	0.147	590
plywood (from 9.5 mm to 18 mm)	negligible0.01	40-57
fibreboard sheathing	0.012-1.91	100-2900
17 mm wood sheathing	high-depends on no. of joints	982
Insulation		
27 mm foil-faced polyisocyanurate	negligible	4.3
27 mm paper-faced polyisocyanurate	negligible	61.1
25 mm extruded polystyrene	negligible	23-92
25 mm expanded polystyrene (Type 2)	0.0214	86-160
fibrous insulations	very high	very high
25mm polyurethane spray foam-low density	0.011	894-3791
25mm polyurethane spray foam-medium density	negligible	96(2)
Membrane-type materials		
asphalt-impregnated paper (10 min paper)	0.0673	370
asphalt-impregnated paper (30 min paper)	0.40	650
asphalt-impregnated paper (60 min paper)	0.44	1800
water-resistive barriers (9 materials)	negligible-4.3	30-1200
0.15 mm polyethylene	negligible	1.6-5.8
asphalt-saturated felt (#15)	0.153	290
building paper	0.2706	170-1400
spunbonded polyolefin film (expanded)	0.9593	3646
Other materials		
brick (6 materials)	negligible	102-602
metal	negligible	negligible
mortar mixes (4 materials)	negligible	13-690
stucco	negligible	75-240
50mm reinforced concrete (density: 2 330 kg/m³)	negligible	23

Figure 13.10
Air and Vapour Permeance Values of Commonly Used Materials (9.25.5.1.)

To check the location of a low air and vapour permeable sheathing (less than 0.1 L/s•m² air leakage and less than 60 ng/Pa•s•m² vapour permeance) within a wall assembly, calculate the ratio of outboard to inboard thermal resistance, then compare the section ratio to minimum ratio on the chart. The ratio of outboard to inboard thermal resistance is 1.02/4.07 = 0.25.

This wall assembly would meet thermal resistance ratio requirements in locations with less than 5000 degree-days.

To meet Code requirements, a wall system must provide the required minimum thermal resistance and have an appropriate vapour barrier included on the warm side of the wall insulation. Typically, 6 mil polyethylene on the warm side would be used.



Test Section Ratio

Material	Outboard RSI (R)	Inboard RSI (R)
exterior air film	0.03 (0.17)	-
metal or vinyl siding	0.12 (0.68)	-
insulating sheathing	0.87 (5.0)	-
glass fibre batt	-	3.87 (22)
air/vapour barrier	-	neg.
13 mm gypsum board	-	0.08 (0.45)
interior air film	-	0.12 (0.68)
Total Resistance	1.02 (5.85)	4.07 (23.13)
Total Resistance	5.09 (28.98)	

Allowable Ratio of Outboard to Inboard Thermal Resistance

Heating Degree-Days of Building Location, Celcius Degree-Days	Minimum Ratio
up to 4999	0.20
5000 to 5999	0.30
6000 to 6999	0.35
7000 to 7999	0.40

Figure 13.11
Locating Low Air and Vapour Permeable Sheathings in Building Envelopes (9.25.5.1.)

THERMAL INSULATION

BUILDING CODE REFERENCES

DIVISION B

9.25.2.1. Required Insulation
9.25.2.2. Insulation Materials
9.25.2.3. Installation of Thermal Insulation
9.25.2.4. Installation of Loose-Fill Insulation
9.25.2.5. Installation of Spray-applied Polyurethane
9.32.3.10. Ducts

SUPPLEMENTARY STANDARD SB-12
2.1.1.6. Insulation of Foundation Walls

This section of the Guide deals with thermal insulation requirements. Refer to Chapter 6, Fire Safety and Sound Control for fire protection and acoustic insulation requirements.

General

Insulation is required for all walls, ceilings and floors separating heated space from unheated space, the exterior air or the exterior soil. Requirements for insulation help to reduce the incidence of condensation on interior surfaces of insulated assemblies. Insulation helps maintain comfortable temperatures for the occupants and, of course, helps to conserve energy. Figure 13.12 illustrates where insulation is required.

Materials

Insulation materials are governed by standards referenced in Article 9.25.2.2. of the Code. Insulation in contact with the ground must be inert to the action of soil and water and must possess insulative properties not significantly reduced by moisture.

Type 1 expanded polystyrene insulation as described in CAN/ULC-S701 "Thermal Insulation, Polystyrene, Boards, and Pipe Covering" must not be used as roof insulation applied above the roofing membrane.

It is always advisable to check that insulation products comply with applicable standards and Code requirements at the design stage and prior to installation. The following page lists important characteristics of commonly available insulating materials.

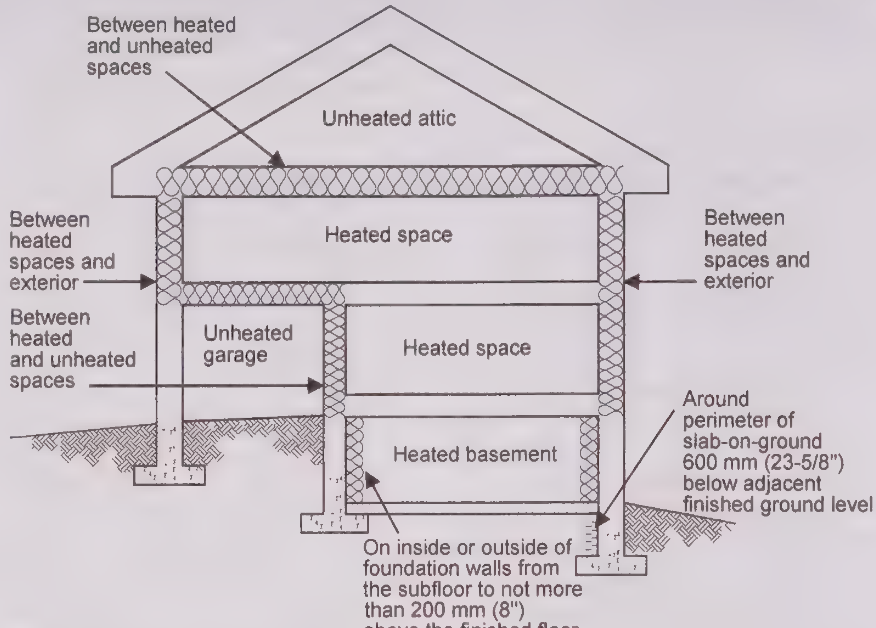


Figure 13.12
Locations Requiring Insulation
(9.25.2.3.)
(SB-12)

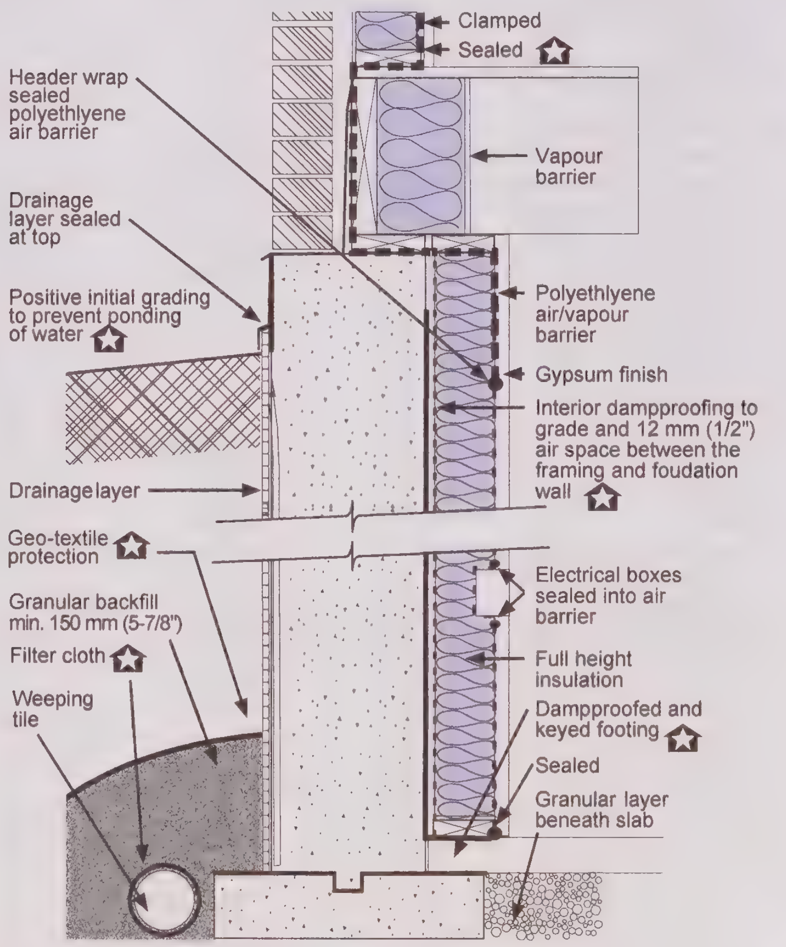


Figure 13.13
Interior Frame Wall with Batt Infill

Insulation Materials: Summary Information

Insulation Material	RSI/mm (R/in)	Density kg/m^3 (lb/ft^3)	Permeance $ng/Pa\ m^2 s$ ($grain/ft^2\ hr\ (in\ Hg)$)	Flame Spread	Smoke Development
Batt Type					
Glass Fibre	0.022 (3.2)	24-40 (1.5-2.5)	1666 (29)	15	0
Mineral Fibre	0.024 (3.5)	24-64 (1.5-4.0)	1666 (29)	15	0
Loose Fill					
Glass Fibre	0.020 (2.9)	9.8-40 (0.61-2.5)	1666 (29)	15	0
Mineral Fibre	0.023 (3.3)	24-40 (1.5-2.5)	1666 (29)	15	0
Cellulose Fibre	0.025 (3.6)	35-48 (2.2-3.0)	1666 (29)	75	15
Boardstock					
Expanded Polystyrene (Type I and II)	0.026 (3.8) to 0.030 (4.4)	14.4 - 25.6 (0.9 - 1.6)	115-300 (2.0 - 5.2)	200	500
Extruded Polystyrene (Type III and IV)	0.034 (5.0)	25.6 - 32 (1.6 - 2.0)	23 - 92 (0.4 - 1.6)	200	500
High Density Glass Fibre	0.029 (4.2) to 0.031 (4.5)	64 - 144 (4.0 - 9.0)	1725 (30)		
Foil Face Polyisocyanurate	0.041 (6.0)	25.6 - 32 (1.6 - 2.0)	<0.25 (15)		
Spray Type					
Cellulose Fibre	0.024 (3.5)	varies		<25	<25
Polyurethane (med. density)	0.038 (5.5) to 0.041 (6.0)	varies	varies	<25	<300
Polyurethane (low density/ semi-flexible)	0.025 (3.6)	varies		<25	up to 500

Notes

Insulation is not only used to moderate heat loss, but can also be used in rated fire assemblies and to attenuate sound transmission. In these cases, the full range of the insulation's physical properties may likely need to be considered.

There may be various advantages and disadvantages to the types of insulation that should be considered before selection. Find out about the product's:

- availability
- combustibility
- density
- moisture resistance
- air infiltration resistance
- protection against ultraviolet rays
- potential for drainage
- compression susceptibility
- tendency to settle
- certified installers requirement

Manufacturers can provide additional details on specific products.

Additional Notes: Materials with a permeance less than 45 (0.8) are considered Type II vapour barriers.
Materials with a permeance less than 15 (0.26) are considered Type I vapour barriers.

Installation

In general, insulation must be installed to provide a reasonably uniform thermal resistance over the entire face of the insulated area. Insulation applied between furring or framing must extend the full width and length of these spaces, and should be installed in a manner which reduces convective air movement in the cavity. Figure 13.14 depicts common errors when installing insulation.

Batt-type insulation manufactured with no membrane on either face must be installed so that at least one face is in full and continuous contact with cladding, sheathing or some other low air permeance membrane. This requirement is intended to prevent air from moving through the insulation and significantly reducing its thermal resistance.

Loose fill insulation must only be used on horizontal surfaces, except mineral fibre or cellulose loose fills are permitted to be installed in attic spaces over ceilings with slopes of 4.5 in 12 or less. Water-repellant loose fill insulation is also permitted between the outer and inner wythes of masonry cavity walls. Loose fill insulation may also be used in existing walls. Where soffit venting is used, measures must be taken to prevent the blockage of soffit vents with loose fill insulation (see Figure 13.15).

Where blown-in insulation is installed above-ground or below-ground wood frame walls of new buildings, the density of the installed insulation shall be sufficient to preclude settlement, the insulation shall be installed behind a membrane that will permit visual inspection prior to installation of the interior finish and will not interfere with the installation of the interior finish, and no water shall be added to the insulation, unless it can be shown that the added water will not adversely affect other materials in the assembly.

Spray-applied polyurethane insulation must be installed in accordance with CAN/ULC S705.2, "Thermal Insulation Sprayed Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibility Specification".

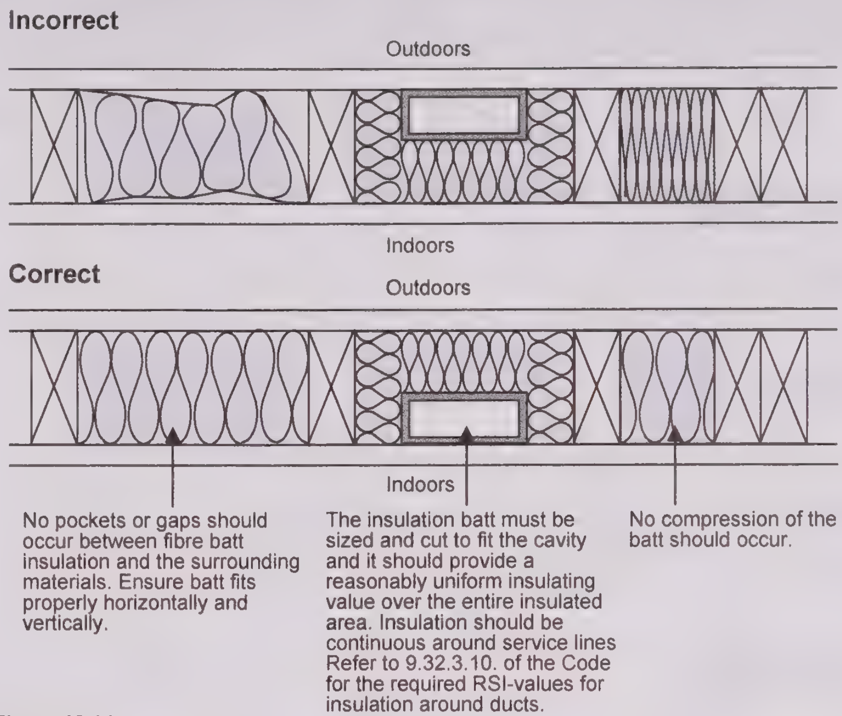


Figure 13.14
Proper Installation of Batt
(9.25.2.3.)

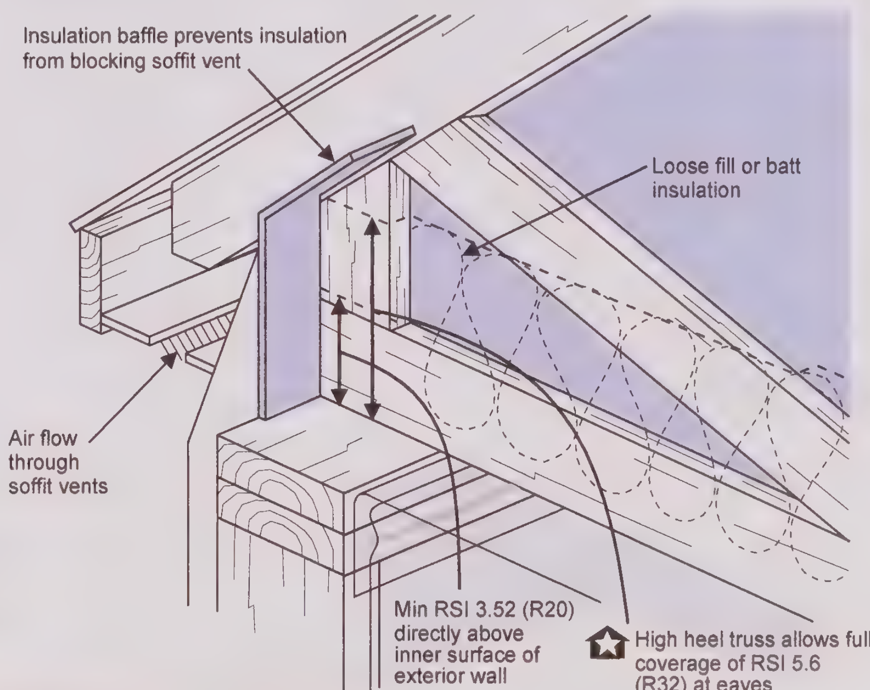


Figure 13.15
Preventing the Blockage of Soffit Venting
(9.25.2.4.(6))

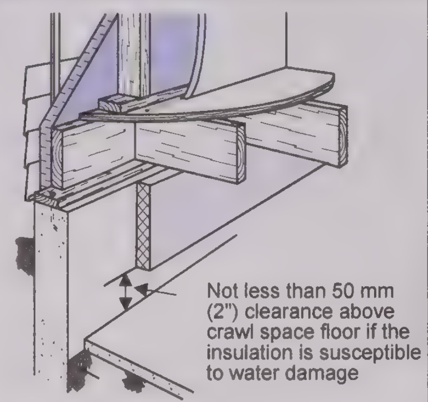


Figure 13.16
Extent of Insulation for Heated Crawl Space Walls (9.25.2.3.(4))

Figure 13.16 shows that interior foundation wall insulation in crawl spaces be provided with a 50 mm (2") clearance above the crawl space floor, if the insulation is of a type which may be damaged by water or significantly reduced in thermal effectiveness.

Concrete slabs-on-ground must be properly insulated to prevent heat loss. The insulation must extend not less than 600 mm (23-5/8") below exterior ground level and must have a minimum RSI of 1.76 (R10). Basement slab edges within 600 mm (23-5/8") of exterior ground level (e.g. walkouts) must also comply to these requirements; in some situations, the entire slab may require full insulation, such as when the entire slab is less than 600 mm (23-5/8") to the exterior ground level, or when the slab is heated, see Figure 13.19. Figure 13.17 shows four different insulation configurations. Where footings do not extend below the depth of frost penetration, frost protection must be considered. See Chapter 2 for more details.

Where insulation is exposed to the weather and subject to mechanical damage, it must be protected with not less than 6 mm (1/4") asbestos-cement board, or 6 mm (1/4") preservative-treated plywood or 12 mm (1/2") cement parging on wire lath applied to the exposed face and edge of the insulation.

Ducts, outside the heated envelope, must be insulated and sealed according to 6.2.4.3. and 9.32.3.10 of the Code. (see Figure 13.18).

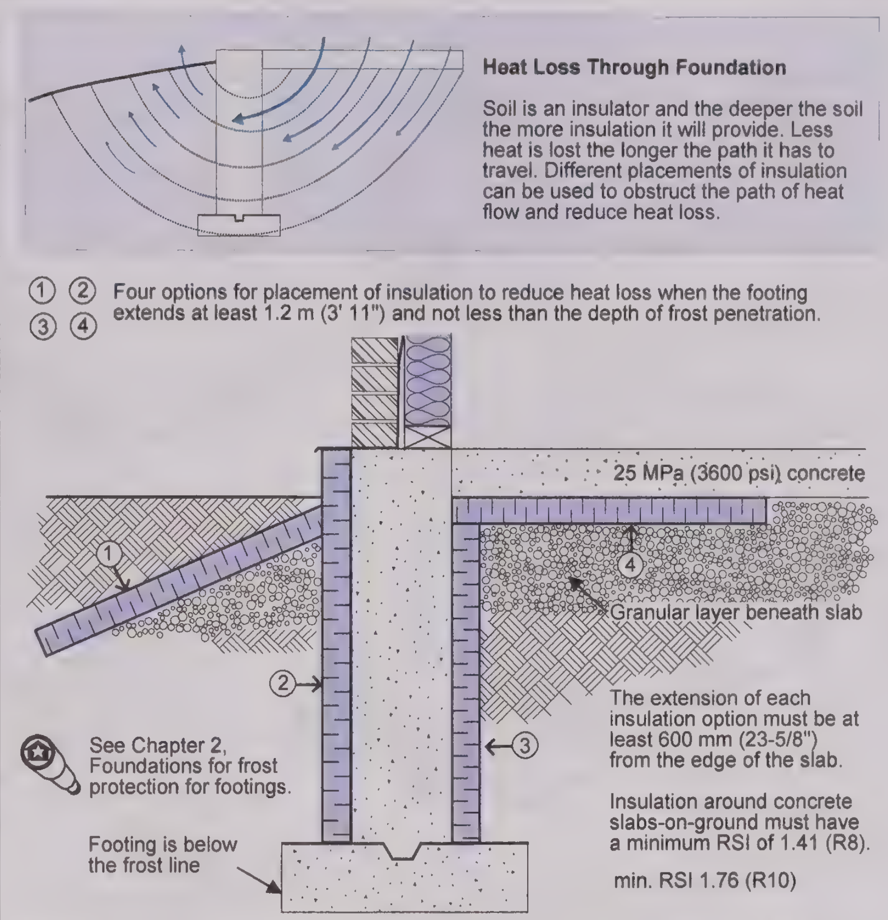


Figure 13.17
Slab-On-Ground Foundation Insulation Options (9.25.2.3.) (SB-12 2.1.1.6.)

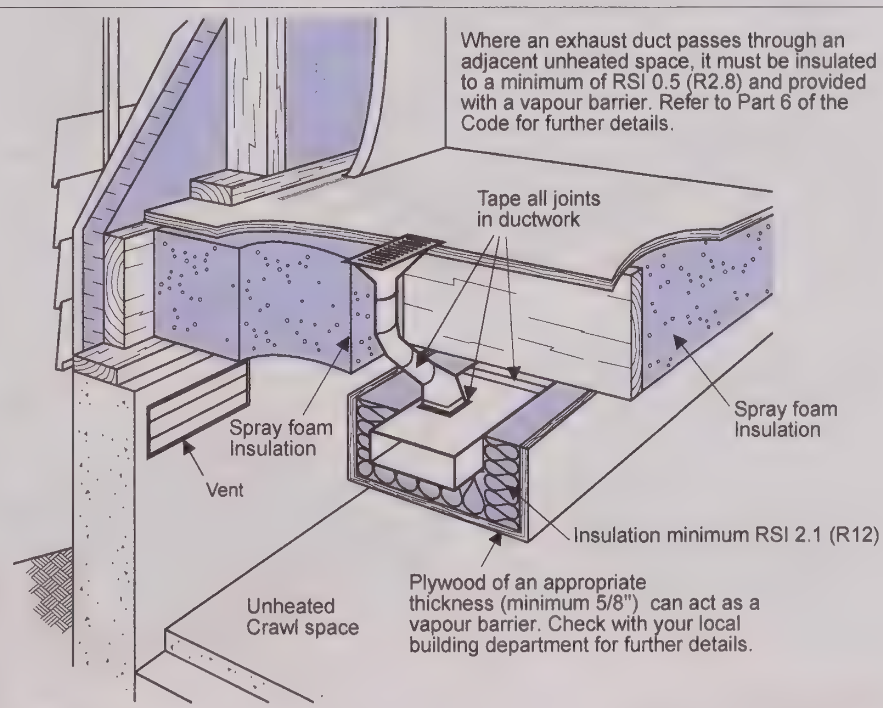
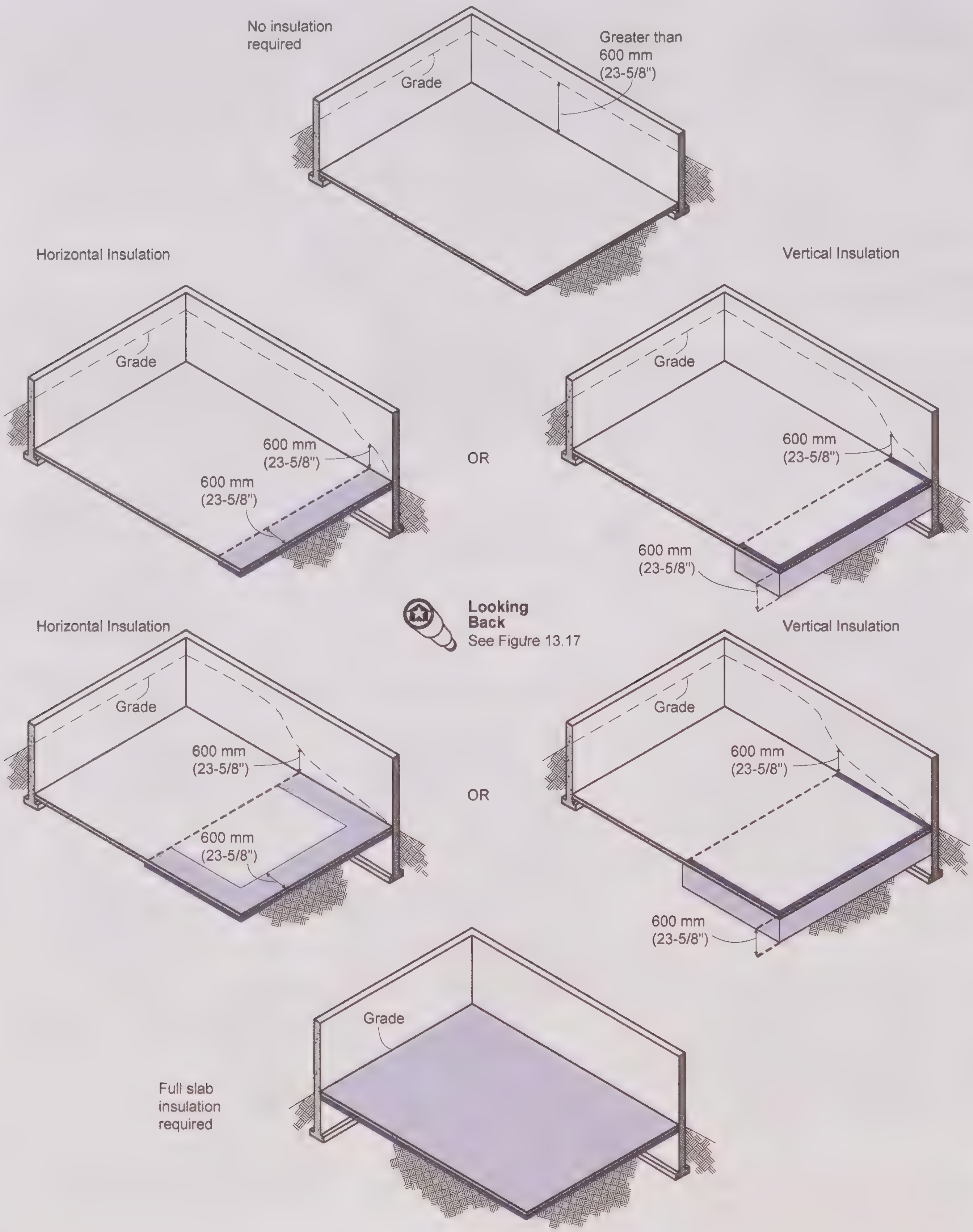


Figure 13.18
Duct Insulation (6.2.4.3.) (9.32.3.10.)



Looking Back
See Figure 13.17

Figure 13.19
Basement Slab Insulation

(SB-12 2.1.1.6.)

All interior insulation and vapour barriers must be protected from mechanical damage by a covering of gypsum board, plywood, particleboard, waferboard, hardboard or equivalently performing material. Mineral fibre insulation installed in unfinished basements is exempted from this requirement provided it is covered with a polyethylene vapour barrier of at least 0.15 mm (6 mil) thickness.

Insulation in factory-built buildings must be installed so that it will not become dislodged during transportation.

Foundation walls enclosing heated spaces require near full height insulation be installed from the underside of the subfloor to not more than 200 mm (8") above the finished floor of the basement. Refer to Figure 13.20. The insulation may be provided on either the interior or exterior of the foundation wall, or a combination with an equal thermal performance. As a best practice, where an overlapping interior and exterior insulation is used, the overlap should not be less than four times the thickness of the foundation wall. See Figure 13.21 and Figure 13.22. In all cases, a foundation wall drainage system is required by Article 9.14.2.1. of the Code. See Chapter 2, Foundations.

Where a foundation wall is constructed of hollow masonry units, one or more of the following measures must be taken to control convection currents in the core spaces of the blocks:

- all of the core spaces must be filled;
- at least one row of semi-solid blocks must be installed at or below grade (see Figure 13.20); or
- an equivalent method may be employed.

Hollow unit masonry walls which penetrate the ceiling into a roof or attic space must be sealed at or near the level of the ceiling so as to avoid air within the blocks from entering the roof or attic space. This can be done by either:

- capping the masonry units or
- installing flashing material across the entire width of the masonry.

Interior foundation insulation must be protected from interior sources of water vapour by a vapour barrier, unless the insulation has vapour barrier characteristics. All insulation installed on the interior of foundation walls must be sealed at the top and bottom to reduce air circulation through the assembly or behind the insulation (see Figure 13.20).

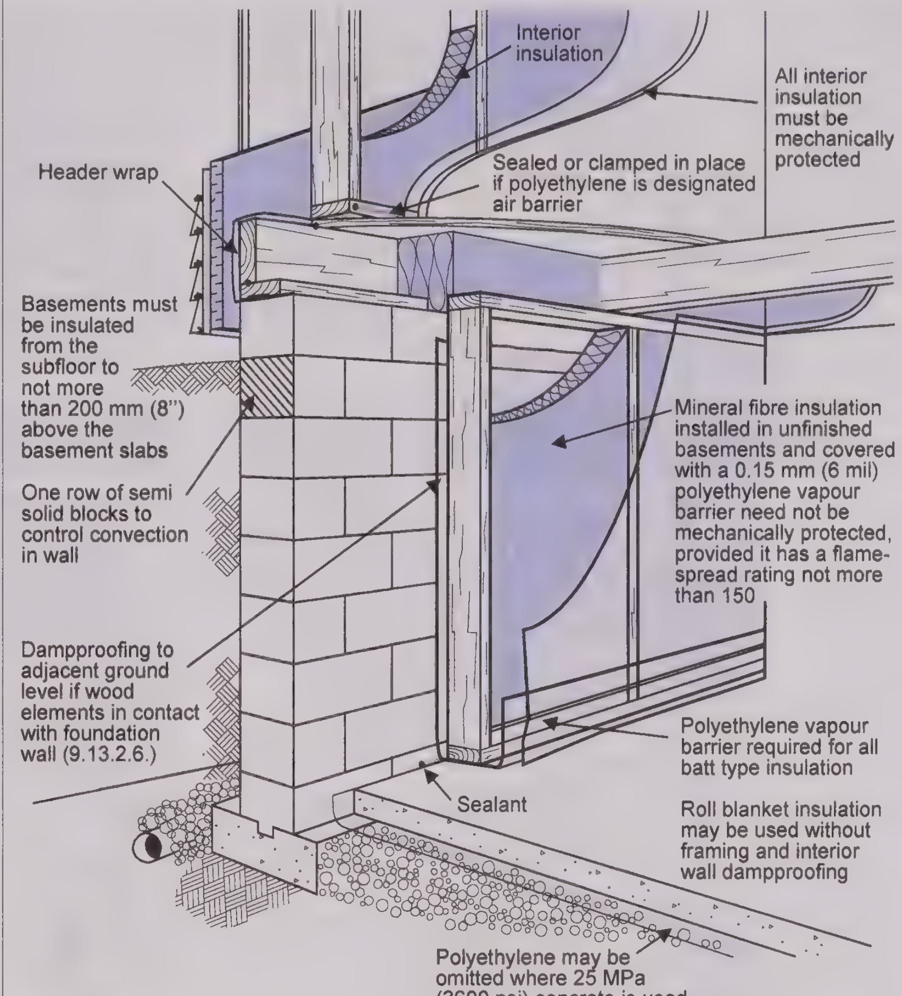


Figure 13.20
Insulation Requirements

Insulating concrete forms (ICFs) offer the builder a system that combines concrete construction and insulation (Figure 13.23). The system offers exceptional thermal resistance and protection from moisture. Application requires experienced installation crews and careful planning to avoid potential problems.

On the interior, the ICFs take up little more space than a typical foundation wall. ICFs are easily finished as most systems provide nailing surfaces for sheathing and finishing materials. Some ICF systems may provide adequate vapour protection, while other may require the addition of an interior vapour barrier. In all cases, manufacturer instructions should be followed in constructing this system. See Chapter 2: Foundations for further details.

Better Building Note

Garage Ceiling

Where there is a heated space above, use approved spray foam or header wrap instead of batts to enhance airtightness.

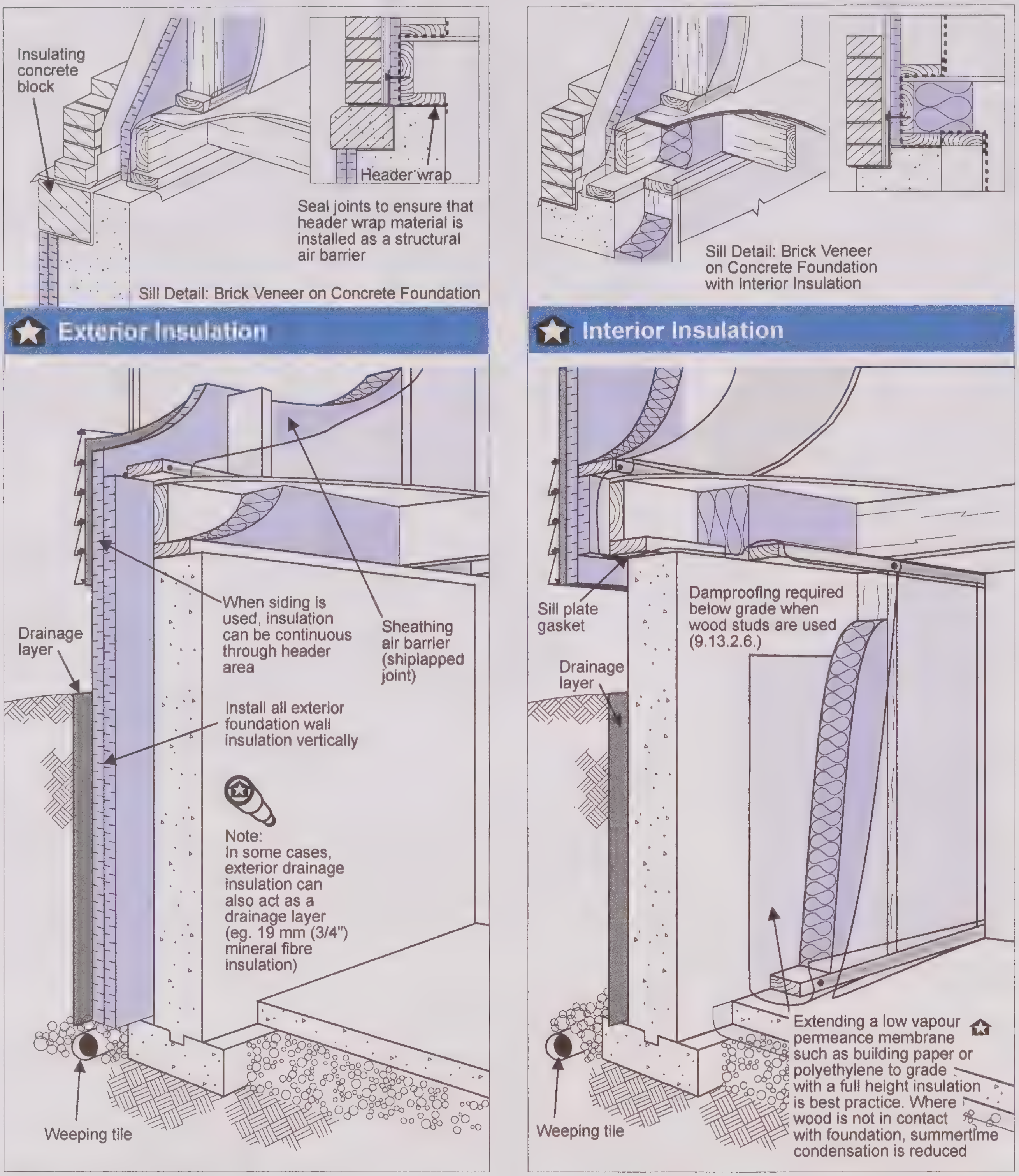


Figure 13.21
Example of Exterior and Interior Insulation (12.3.2.4.)

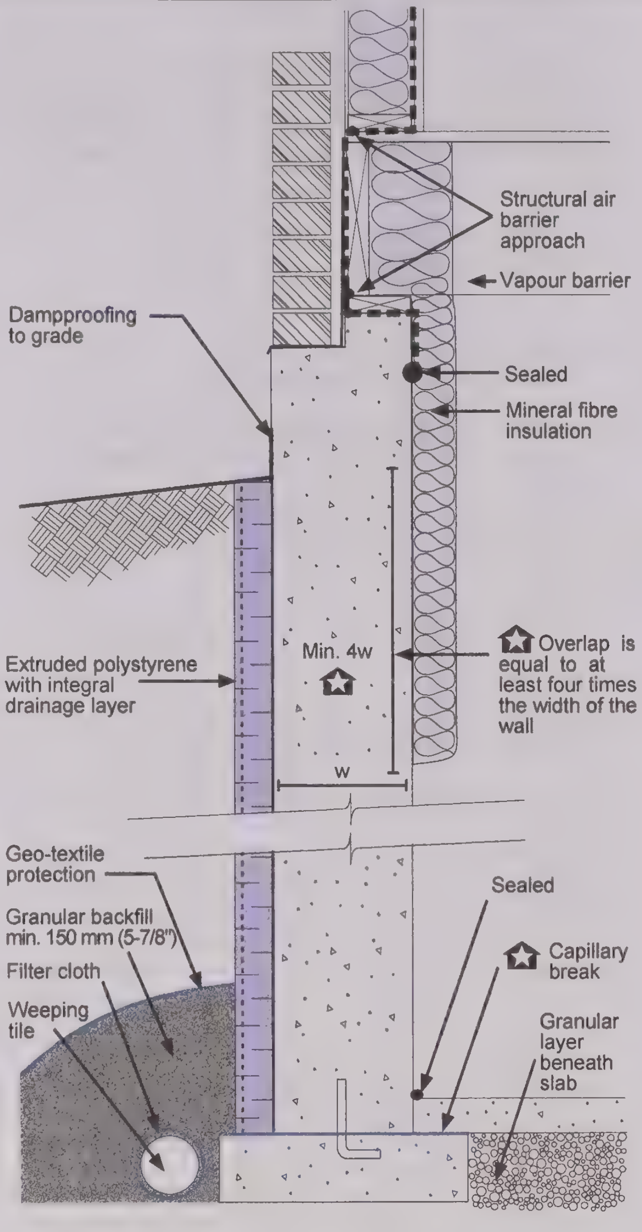


Figure 13.22
Insulation used on the Interior and Exterior

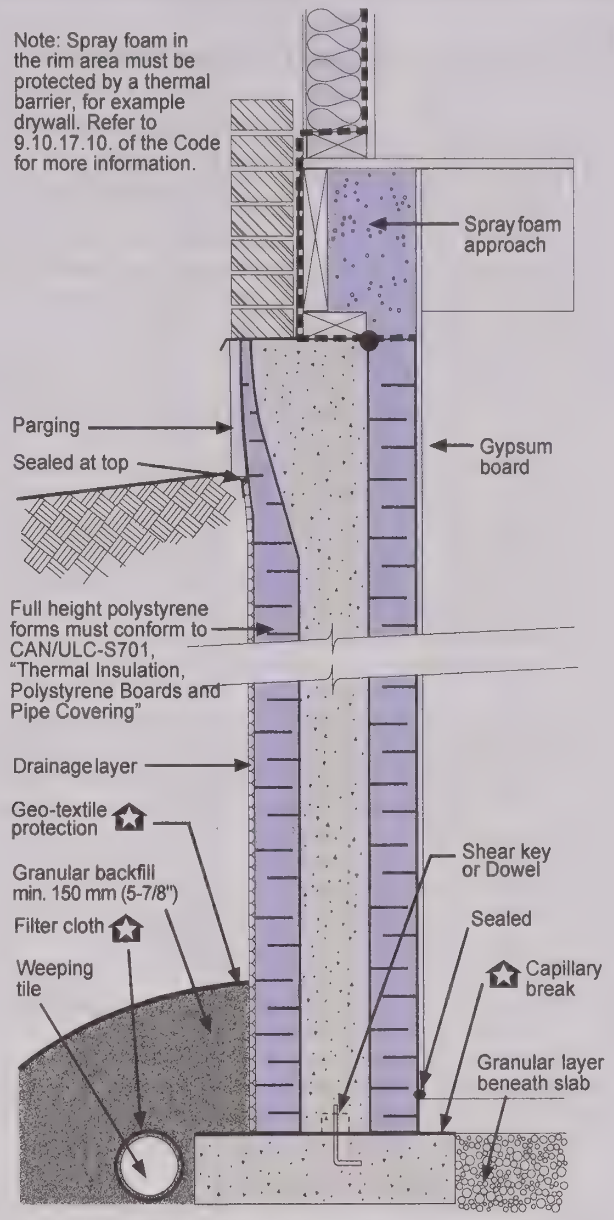


Figure 13.23
Insulating Concrete Forms

(9.15.4.1.)
(SB-12)

High Performance Basements

Increasingly, consumers are looking to use every space within their home more fully. More and more they expect that their basements provide the same level of comfort, livability, and moisture control as above grade spaces. Homebuyers are not willing to accept the damp, cold, wet, moldy basements of the past. For builders, basements have traditionally been the source of frustration as they are often constructed with serious defects. Creating a healthy, comfortable living space in the basement that meets the home buyer's expectation can be a challenge.

As one of the major sources of heat loss within a home, basements are now required to be insulated near full height. For builders, this presents an opportunity to perfect their craft and to deliver the high performance living space that their home buyers demand. Builders who ignore the challenge will likely continue to have difficulties with moisture, mold and homeowner complaints.

Ultimately, it is the builder's responsibility to identify the risks associated with a particular site condition and select and execute the systems that will best result in safety and durability of the structure as well as meeting the expectations of the homeowner. Typically, by using a systems approach, potential problems are predicted and averted by applying a combination of materials and components that provide multiple layers of protection.

Getting it right begins by understanding materials, components, and systems that are used in the basement and how they work together. The high performance basement must be capable of supporting the superimposed loads of the structure above, while also resisting the lateral loads imposed by the surrounding soil and the hydrostatic pressures of the water within the soil. It reduces the exfiltration and infiltration of air and other harmful gases from the surrounding soils. The high performance basement is durable and cost-effective balancing initial capital costs with operating costs including those costs associated with heating, cooling, repair, and warranty.

For most builders, building a high performance basement means keeping it dry and free of moisture. Controlling moisture from getting into the basement from all its sources becomes the big challenge and requires:

- Preventing water from ponding against the outside of the basement wall, particularly during construction.
- Ensuring rain water that infiltrates into the soil is drained away from the building.
- Ensuring water from a high water table does not crack the structure or leak into the basement.
- Protecting the building interior from dampness that wicks into the concrete from the wet soil.
- Retarding the diffusion of water vapour to minimize condensation both from outside in (in summer) and inside out (in winter).
- Ensuring basement air barriers are continuous to minimize vapour movement from air leakage.
- Providing suitable protection from frost heave.

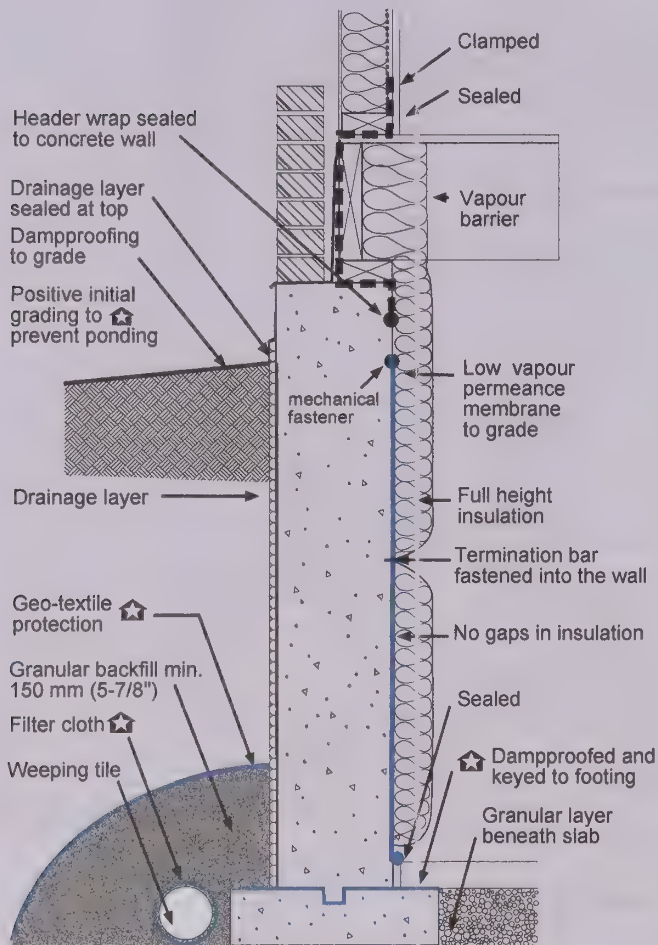
The builder will need to select a system that responds to the specific conditions of the site, the intended interior use of the basement and the capabilities of the available trades and that balances performance and cost (initial and long-term). On the ideal site featuring freely draining soils, properly sloped grading, proper orientation, a dry climate, minimal interior usage, and a low and stable water table simply meeting minimum requirements will likely deliver a properly performing product. Ideal conditions however, are seldom found. In other cases, builders should consider appropriate measures. Best practices in new home construction generally represent a set of techniques and skills above and beyond the minimum standards prescribed by Ontario's 2012 Building Code. Of course, best practices can involve increased first costs but most builders understand the balancing of cost and performance as systems are evaluated and selected.

Best practice solutions intended to keep interior basement spaces dry are often inexpensive and simple to apply.

Looking Back

See Chapter 2 Foundations

Full Height Blanket System



Detailed Section of a Typical Foundation Wall with Near Full Height Basement Insulation and Best Practice Techniques

Ten points to summarize what the best practice builder should consider:

1. Around the building exterior, grading should place early and often so that no free water pools against the foundation wall loading the concrete with moisture.
2. To reduce the wicking of water into the interior space one of the simplest best practices involves applying a dampproofing (spray-on or proprietary membrane) to the top of the footing before the wall is erected.
3. Careful installation of the drainage tile system around the perimeter of the foundation is important. Ensure that the slope of the pipe provides effective drainage.
4. Cover the granular layer with a geo-textile cloth to prevent the drainage system from becoming clogged.
5. After the wall is placed, a slip plane, as simple and inexpensive as polyethylene can be added to the exterior of a foundation to prevent frozen soil from adhering to the concrete or unit masonry. A drainage layer can also provide a slip plane, but any damage to the layer that is evident in the spring would need to be repaired.
6. On the interior, a capillary break (space or membrane between wood framing and concrete) can prevent moisture from wicking from the concrete to wood or other interior materials which can decay or deteriorate as a result.
7. Construction moisture in freshly cast concrete walls should have an opportunity to dry out before walls are insulated and vapour barriers installed, particularly in late summer. Where this is not possible, a number of techniques are available to minimize the likelihood of serious moisture accumulation. Using a low vapour permeance insulating board on the inside of the foundation wall, avoiding summertime air-conditioning in the basement, and increasing basement ventilation are among the techniques that have been reported to help mitigate summertime condensation in basements.
8. Vapour barriers should be fitted to all thermally insulated components.
9. Insulation should be continuous (without any gaps) along the foundation wall, and should not be damaged, overly compressed or exposed to sources of moisture.
10. Air infiltration is of extreme importance to the best practice builder, as it is the cause of many problems. First of all, a simple seal along the junction of the slab and foundation wall will prevent air leakage from below grade. Header areas are a very significant source of air leakage as the air barrier is often damaged during construction, or is not properly sealed. Header air barriers need to be continuous and sealed to the foundation wall. In fact, the entire envelope air barrier must always be continuous from basement slab to top storey ceiling.

Controlling Summer Moisture

To prevent condensation from accumulating within the insulation from construction moisture, care should be taken to insulate the foundation where possible after the concrete has had an opportunity to dry. Avoid air-conditioning during hot humid summer days when summer condensation is most prevalent during the first year after construction and consider using a dehumidifier during that first year. On average, it takes between one and two years for the excess water within a solid concrete foundation wall to dry out. Ensure that the air barrier at the first floor header is continuous and sealed to the foundation wall or to the interior foundation air barrier. Improper initial grading can load the concrete with moisture from ponding rainwater.

Maintaining a positive slope away from the foundation is an important measure to keep basements dry. Using a capillary break at the top of the footing can help reduce the incidence of summer condensation.

Summertime moisture problems can be controlled by recognizing the mechanisms that drive moisture through foundation walls and by taking the right steps to avoid problems.

These include:

- proper initial grading to avoid water ponding next to the foundation wall,

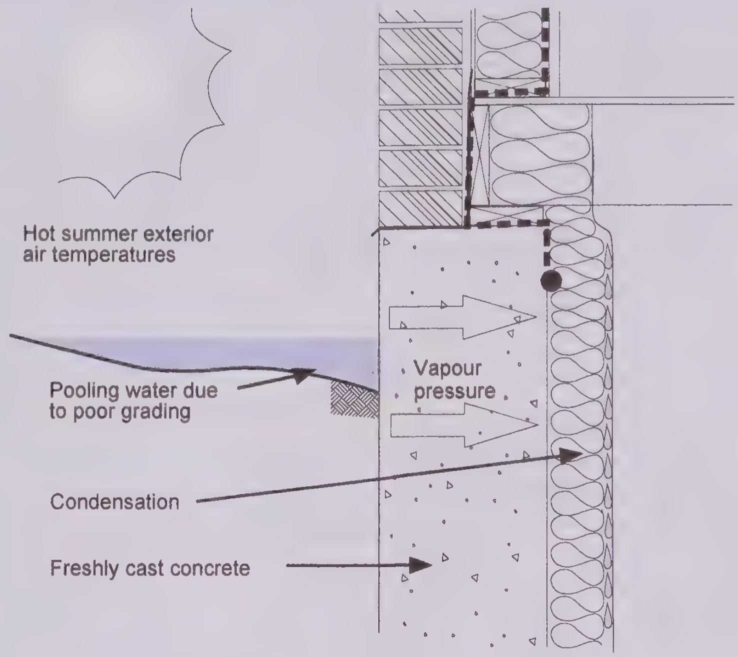
- ensuring dampproofing or drainage layers extend above grade,

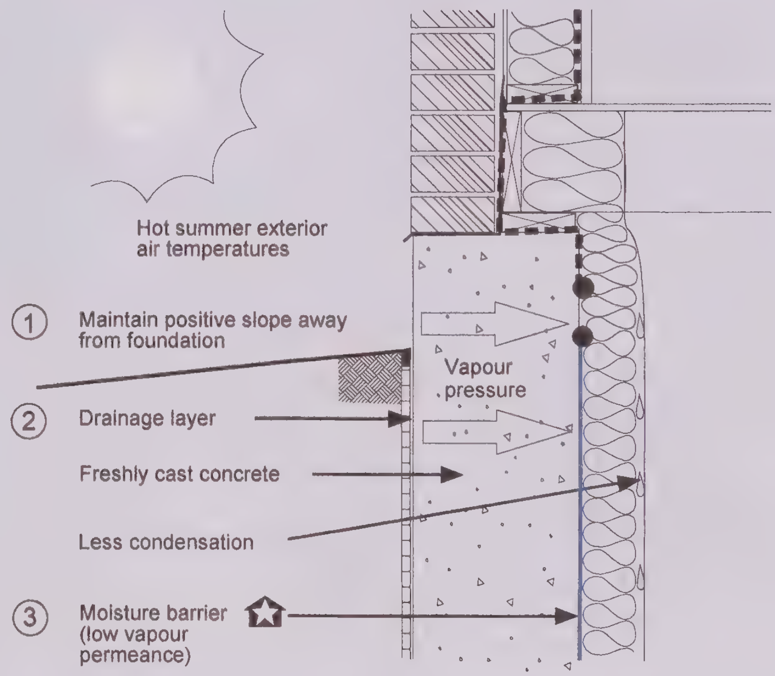
- ensuring a capillary break exists between the footing and the wall,

- ensuring a proper air barrier is installed at the header,

- allowing where possible the cast-in-place concrete foundation wall to dry out before installing the vapour barrier.

- installing a low vapour permeance membrane (eg. extruded polystyrene, building paper, etc.) against the interior of the foundation wall below grade.





ENERGY EFFICIENCY REQUIREMENTS

BUILDING CODE REFERENCES

DIVISION B

9.25.1.1.	Scope and Application
9.25.5.1.	General
12.2.1.1.	Energy Efficiency Design Before January 1, 2017
12.2.1.2.	Energy Effciency Design After December 31, 2016

SUPPLEMENTARY STANDARD SB-12

1.1.1.1.	Energy Efficiency
1.1.1.2.	Compliance Options Before January 1, 2017
1.1.1.3.	Compliance Options After December 31, 2016
1.2.1.1.	Energy Efficiency Design
2.1.1.1.	Energy Efficiency
2.1.1.2.	Energy Efficiency for Buildings Located in Zone 1
2.1.1.3	Energy Efficiency in Buildings Located in Zone 2
2.1.1.4.	Elements Acting as a Thermal Bridge
2.1.1.5.	Log Wall Construction and Post, Beam and Plank Construction
2.1.1.6.	Insulation of Foundation Walls
2.1.1.8.	Thermal Performance of Windows, Skylights and Sliding Glass Doors
2.1.1.9	Minimum Thermal Resistance of Doors
2.1.1.10.	Additions to Existing Buildings
2.1.1.11.	Drain Water Heat Recovery
2.1.2.1.	Required Performance Level
2.1.3.1	Other Acceptable Compliance Methods

Two alternatives are available for establishing the energy efficiency of houses that use fossil fuel or electricity, and are occupied during the winter months. Dwelling units can conform to:

1. the performance requirements of the EnerGuide Rating System, achieving a rating of 80 or more when evaluated in accordance with NRCan "EnerGuide for New Houses: Administrative and Technical Procedures", or
2. Supplementary Standard SB-12 Chapters 1 and 2.

The specific requirements for thermal insulation are found in Supplementary Standard SB-12 of the Code in addition to those found in Section 9.25. The insulation of heating and ventilating ducts is governed by the requirements of Section 9.32. and by Part 6 of the Code.

EnerGuide 80

An energy efficiency level of EnerGuide 80 is achieved by complying with the technical requirements of the EnerGuide Program and demonstrated by using NRCan's HOT2000 energy modelling software. Each dwelling unit would have to be individually modelled and have a blower door test performed to demonstrate its performance according to NRCan's EnerGuide for New Houses procedures. Although registration in the EnerGuide program is not required, registration and acquiring an EnerGuide label can provide assurance and enhanced confirmation that EnerGuide 80 is achieved. In all cases, however, a performance level equal to EnerGuide 80 must be demonstrated.

Supplementary Standard SB-12

SB-12 provides three compliance paths: (1) prescriptive compliance, (2) performance compliance, and (3) other compliance methods namely the ENERGY STAR for New Homes voluntary program.

Prescriptive Compliance Packages

The Code provides prescriptive compliance packages as shown in Figures 13.25 to 13.28. The Code's requirements are based on multiple factors: degree-day zone location (Zone 1, less than 5000 degree-days Celsius, and Zone 2, 5000 degree-days Celsius or more), the space heating energy efficiency, and whether electric resistance space heating is used. The number of degree-days for a particular location may be found in Supplementary Standard SB-1 of the Code or may be obtained from the local building department.

The definition of an electrically heated house is provided in the Code: a house is considered to be electrically heated if more than 10% of its heating capacity is provided for by:

- electric resistance unitary baseboard heating,
- electric resistance unitary cabinet heating,
- electric resistance ceiling cable or floor cable heating,
- electric resistance central furnace heating,
- electric hot water space heating, or
- air source heat pumps in combination with electric resistance backup heating.

Each compliance package groups the insulation, windows, and mechanical systems that can be used in a house. Each package is intended to represent similar levels of energy efficiency.

Ceilings

The thermal resistance of insulation for exposed roofs or ceilings may be reduced near the eaves as the space is compressed by the slope of the roof and by ventilation clearances. The reduced thermal resistance near the eave over the top plates must be not less than RSI 3.52 (R20). In addition, areas directly above attic hatches are permitted to be reduced to not less than RSI 3.52 (R20).

Insulation

Required insulation levels shown in the packages are expressed in terms of installed nominal insulation values rather than the effective R-value of the assembly. Reflective surfaces of insulating materials may not be considered in calculating thermal resistance values according to the Code. While the

Degree Days

Degree-days are a measure of the severity of a location's climate. The heating degree-days for a location measure the difference in average daily temperatures from 18°C for each day over the entire year. The degree-days associated with Markham are approximately 4000 DD while those for Timmins are approximately 6000 DD. A building that costs $2000 per year to heat in Markham would cost $3000 to heat in Timmins all else being equal. (See Supplementary Standard SB-1 of the Code for further details).

insulation of a wall is measured as R-value, window performance is measured as U-value. Note the required U-value is for the entire window assembly, not through the centre of glass.

Windows

Restrictions are placed on the window to wall ratios permitted under the compliance packages. Windows are permitted to be 17% or less of the wall area. Calculation of the gross wall area includes all above grade wall areas, floor rim board areas, walls that are common between a house and garage or other units, and the portion of steeply inclined roofs that serve as interior walls (greater than 60° to the vertical). Calculation of the gross window area includes windows, skylights, sidelights, glazing in doors, and sliding glass doors. The glazing in main entrance doors or their adjacent sidelights do not need to be included in the gross window area.

If windows are 17-22% of the wall ratio, the coefficient of heat transfer for the windows must be upgraded from the compliance packages, as outlined in Article 2.1.1.1. of SB-12. For example, a required U-value of 1.8 must be upgraded to a U-value of 1.6. This type of window upgrade is additive to any window upgrades required as part of an envelope trade-off.

A building with a window to wall ratio greater than 22% must use the performance path to meet the energy efficiency requirements.

Basement windows that incorporate a loadbearing structural frame are to be double glazed with a low-E coating and does not need to meet the required U-value.

All windows and sliding glass doors separating heated space from unheated space must either conform to the U-value listed in the compliance packages, or corresponding to an energy rating not less than that listed in Figure 13.24.

Doors

Doors separating heated space from unheated space, except for doors on enclosed unheated vestibules and cold cellars, must have a thermal resistance of not less than RSI 0.7 (R4) where a storm door is not provided.

Windows, skylights, and doors are also required to comply with Section 9.7 of the Code.

Envelope Trade-Offs

Trade-offs are permitted for different compliance packages, which allow a reduction of thermal performance for walls, windows, or basements walls if the performance of other components is increased, such as the use of more insulation, better windows, higher efficiency mechanical equipment, or drain water heat recovery units. Only the thermal performance of one of the walls, windows, or basement walls is permitted to be reduced. Trade-offs are shown in Figures 13.29 and 13.30.

2017 Compliance Packages

Example compliance packages for the forthcoming 2017 requirements have been shown in SB-12 as a signal for the building industry. The packages are designed to achieve energy efficiency levels 15% greater than the 2012 compliance packages. These packages, however, are currently under review and the actual packages that will be enforceable may be subject to change. The packages will provide additional detail on insulation installation requirement, such as where insulating sheathing is required or where a high heel eaves would be mandated.

Maximum U-Values and Minimum Energy Ratings (ER) for Glazing for Houses

Component	U-Value ($W/m^2 \cdot K$)	U-Value ($Btu/hr \cdot ft^2 \cdot {}^\circ F$)	Minimum Energy Rating (ER)
Skylight	2.8	0.50	-
Windows and Sliding glass doors	2.0	0.35	17
	1.8	0.32	21
	1.6	0.28	25
	1.4	0.25	29

Figure 13.24
Energy Ratings for Glazing in Houses (SB-12 2.1.1.8.)

Better Building Note

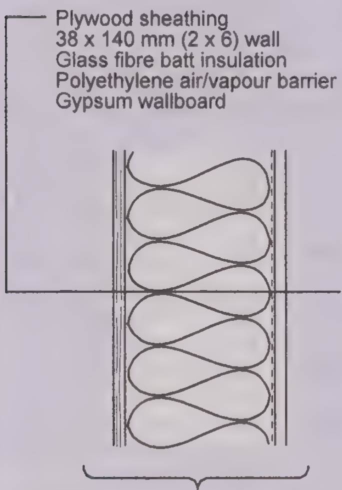
Exterior insulating sheathing applied to insulated walls can often provide a comparable level of thermal resistance to walls insulated with a higher nominal level of insulation, but without insulating sheathing.

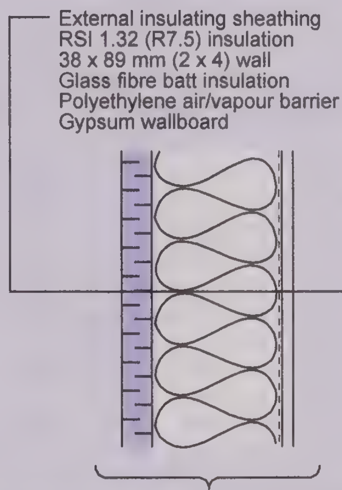
Exterior insulating sheathing reduces thermal bridging - the effect of heat moving through solid framing members to the outdoors - by covering them with an insulating material.

This may not only prove more economical, but more comfortable depending on the type of exterior insulated sheathing used.

For example, as shown below, components used in a wall assembly with RSI 3.52 (R-20) and RSI 3.43 (R-19.5) perform differently.

Make sure to compare each alternative and check for impacts on items like foundation wall thickness before proceeding.





RSI 3.52 (R20)	*Nominal* Thermal Resistance	RSI 3.43 (R19.5)
7.3	Heat Loss Rating (assuming 20% of wall area is comprised of framing members)	5.8* * 20% lower heat loss for same nominal R-value

Elements Acting as Thermal Bridges

Where steel studs, steel joists, or other thermally conductive materials are used, and which act as a thermal bridge to facilitate heat flow through the envelope assembly, the insulation values given in the compliance packages must be increased by 20%, unless it can be demonstrated that the heat flow through the assembly is not greater than through a wood frame assembly. The increase in insulation values is also not required where thermal bridges are insulated with a thermal resistance of at least 25% of the thermal resistance required for the insulated portion of the assembly.

Wood stud framing elements that have a thermal resistance of less than RSI 0.90 (R5) (i.e. 38 x 89 mm (2 x 4) studs (RSI=0.23, R4.35)) must also be insulated with an insulated exterior sheathing with not less than 25% of the required thermal resistance for the insulated portion of the assembly.

Zone 1 Compliance Packages													
Component	A	B	C	D	E	F	G	H	I	J	K[3]	L[4]	M[5]
Ceiling with Attic Space [1] Minimum RSI-Value (R-Value)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space [1] Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor [1] Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade [1] Minimum RSI-Value (R-Value)	4.23 (R24)	4.75 (R27)	4.75 (R27)	4.23 (R24)	4.23 (R24)	4.23 (R24)	4.23 (R24)	4.23 (R24)	3.87 (R22)	3.87 (R22)	ICF 3.87 (R22)	4.23 (R24)	4.23 (R24)
Basement Walls [1] Minimum RSI-Value (R-Value)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	2.11 (R12)	2.11 (R12)	2.11 (R12)	3.52 (R20)	2.11 (R12)	ICF 3.87 (R22)	ICF 3.87 (R22)	3.52 (R20)
Below Grade Slab Entire surface greater than 600 mm (23-5/8") below grade [1] Minimum RSI-Value (R-Value)	0.88 (R5)	-	-	-	-	-	-	-	-	-	-	-	-
Edge of Below Grade Slab equal or less than 600 mm (23-5/8") below grade or Heated Slab [1] Minimum RSI-Value (R-Value)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value (W/m²•K) [2]	1.6	1.6	1.8	1.8	1.8	1.8	1.8	2	1.8	1.8	1.8	1.8	1.8
Skylights Maximum U-Value (W/m²•K) [2]	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	90%	90%	94%	94%	90%	94%	92%	94%	92%	94%	90%	94%	90% [7] Combo
Minimum HRV Efficiency [6] where HRV is required	-	-	-	-	55%	60%	60%	70%	55%	60%	-	-	-
Domestic Hot Water Heater Minimum Efficiency Factor (EF)	0.57	0.57	0.62	0.67	0.57	0.57	0.62	0.67	0.62	0.67	0.57	0.57	0.80 [7] Combo

Notes:
(1) Except for notes (3) and (4), the values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m² • K)/W.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m² • K). See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.
(3) Compliance package K applies only to a building with both ICF basement walls and ICF above grade walls. Alternatively, any other compliance package is permitted to be used for a building with both ICF basement walls and ICF above grade walls. The thermal resistance value of an ICF wall is the total thermal resistance of the entire wall assembly.
(4) Compliance package L applies only to a building with ICF basement walls. Alternatively, any other compliance package except compliance package K, is permitted to be used for a building with ICF basement walls. The thermal resistance value of an ICF wall is the total thermal resistance of the entire wall assembly.
(5) Applies to a building with combined space heating and domestic hot water heating system.
(6) Except as required in Subsection 9.32.3. of Division B of the Building Code, an HRV is only required as a part of a compliance package where a minimum efficiency level is specified.
(7) Only the hot water heating equipment shall meet the minimum AFUE or EF specified in the Table or shall be of the condensing type.

Figure 13.25
Zone 1 Space Heating Equipment with 90% AFUE or Higher

(12.2.1.1.)
(SB-12)

Zone 2 Compliance Packages

Component	A	B	C	D	E	F	G	H	I	J	K(3)	L(4)	M(5)
Ceiling with Attic Space (1) Minimum RSI-Value (R-Value)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space(1) Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor (1) Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade (1) Minimum RSI-Value (R-Value)	5.11 (R29)	5 11 (R29)	5.11 (R29)	4.75 (R27)	4.75 (R27)	4.75 (R27)	4.75 (R27)	4.23 (R24)	4.23 (R24)	4.23 (R24)	ICF 3.87 (4) (R22)	4.23 (R24)	4.23 (R24)
Basement Walls (1) Minimum RSI-Value (R-Value)	3.52 (R20)	3 52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	2.11 (R12)	3.52 (R20)	3.52 (R20)	2.11 (R12)	ICF 3.87 (4) (R22)	ICF 3.87 (4) (R22)	3.52 (R20)
Below Grade Slab Entire surface greater than 600 mm (23-5/8") below grade (1) Minimum RSI-Value (R-Value)	0.88 (R5)	-	-	0.88 (R5)	-	-	-	0.88 (R5)	-	-	-	-	-
Edge of Below Grade Slab equal or less than 600 mm (23-5/8") below grade or Heated Slab (1) Minimum RSI-Value (R-Value)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors(2) Maximum U-Value (W/sm²•K)	1.6	1.6	1.8	1.6	1.6	1.8	1.8	1.6	1.6	1.6	1.8	1.8	1.8
Skylights Maximum U-Value (W/m²•K)(2)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	90%	94%	92%	94%	94%	94%	94%	94%	90%	94%	94%	94%	90% (7) Combo
Minimum HRV Efficiency where HRV is required	-	-	60%	-	-	60%	75%	-	60%	60%	-	-	55%
Domestic Hot Water Heater Minimum Efficiency Factor (EF)	0.57	0 57	0.57	0.57	0.67	0.57	0.62	0.67	0.57	0.67	0.57	0.67	0.80 (7) Combo

Notes:
(1) Except for notes (3) and (4), the values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m² • K)/W.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m² • K). See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.
(3) Compliance package K applies only to a building with both ICF basement walls and ICF above grade walls. Alternatively, any other compliance package is permitted to be used for a building with both ICF basement walls and ICF above grade walls. The thermal resistance value of an ICF wall is the total thermal resistance of the entire wall assembly.
(4) Compliance package L applies only to a building with ICF basement walls. Alternatively, any other compliance package except compliance package K, is permitted to be used for a building with ICF basement walls. The thermal resistance value of an ICF wall is the total thermal resistance of the entire wall assembly.
(5) Applies to a building with combined space heating and domestic hot water heating system.
(6) Except as required in Subsection 9.32.3. of Division B of the Building Code, an HRV is only required as a part of a compliance package where a minimum efficiency level is specified.
(7) Only the hot water heating equipment shall meet the minimum AFUE or EF specified in the Table or shall be of the condensing type.

Figure 13.26 (12.2.1.1.)
Zone 2 Space Heating Equipment with 90% AFUE or Higher (SB-12)

Zone 1 Compliance Packages

Component	Compliance Packages for Space Heating Equipment with AFUE 78% to <90%						Compliance Packages for Electric Space Heating	
	A	B	C	D	E	F	AA	BB
Ceiling with Attic Space [1] Minimum RSI-Value (R-Value)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space [1] Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor [1] Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade [1] Minimum RSI-Value (R-Value)	5.11 (R29)	5.11 (R29)	5.11 (R29)	4.75 (R27)	4.75 (R27)	4.75 (R27)	5.11 (R29)	5.11 (R29)
Basement Walls [1] Minimum RSI-Value (R-Value)	3.52 (R20)	2.11 (R12)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	2.11 (R12)
Below Grade Slab Entire surface greater than 600 mm (23-5/8") below grade [1] Minimum RSI-Value (R-Value)	-	-	-	-	-	-	-	-
Edge of Below Grade Slab equal or less than 600 mm (23-5/8") below grade or Heated Slab [1] Minimum RSI-Value (R-Value)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value (W/m²•K) [2]	1.6	1.6	1.8	1.6	1.6	1.8	1.6	1.6
Skylights Maximum U-Value (W/m²•K) [2]	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Space Heating Equipment (minimum AFUE)	78%	84%	84%	84%	78%	84%	-	-
Minimum HRV Efficiency where HRV is required	55%	55%	70%	55%	70%	75%	55%	75%
Domestic Hot Water Heater Efficiency Factor (EF)	-	-	-	-	-	-	-	-

Notes:
(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m² • K)/W.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m² • K). See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

Figure 13.27
Zone 1 Space Heating Equipment with AFUE 78 to <90% or Electric Space Heating (12.2.1.1.) (SB-12)

Zone 2 Compliance Packages			
Component	Compliance Packages for Space Heating Equipment with 78% to <90% AFUE		Compliance Package for Electric Space Heating
	A	B	A
Ceiling with Attic Space (1) Minimum RSI-Value (R-Value)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space (1) Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor (1) Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade (1) Minimum RSI-Value (R-Value)	5.11 (R29)	5.11 (R29)	5.11 (R29)
Basement Walls (1) Minimum RSI-Value (R-Value)	3.52 (R20)	3.52 (R20)	3.52 (R20)
Below Grab Slab Entire surface greater than 600 mm (23-5/8") below grade (1) Minimum RSI-Value (R-Value)	0.88 (R5)	0.88 (R5)	0.88 (R5)
Edge of Below Grade Slab equal or less than 600 mm (23-5/8") below grade or Heated Slab (1) Minimum RSI-Value (R-Value)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value (W/m²•K) (2)	1.6	1.6	1.6
Skylights Maximum U-Value (W/m²•K) (2)	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	78%	84%	-
Minimum HRV Efficiency where HRV is required	75%	60%	75%
Domestic Hot Water Heater Minimum Efficiency Factor (EF)	-	-	-

Notes:
(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m² • K)/W.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m² • K). See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

Figure 13.28
Zone 2 Space Heating Equipment with AFUE 78 to <90% or Electric Space Heating
(12.2.1.1.)
(SB-12)

Zone 1 Required Upgrades for Trade-offs for Compliance Packages where Space Heating Equipment has a 90% AFUE or Higher

Trade-Off		Upgrades to the Compliance Packages (see Upgrades list below)												
		A	B	C	D	E	F	G	H	I	J	K	L	M
above grade min. wall insulation not less than RSI 3.52 (R-20)	any type of insulation	-	-	-	1 plus 7	1 plus 7	1 plus 7, or 2 plus at least two of 3, 4, 5, or 6	1 plus 7, or 2 plus at least two of 3, 4, 5, or 6	1 plus 7, or 2 plus at least two of 3, 4, 5, or 6	1	1 or 2	-	-	1 plus 7
	blown-in or spray foam insulation	-	-	-	1, plus one of 3, 4, 5, or 6	1, plus one of 3, 4, 5, or 6	1 or 2, plus one of 3, 4, 5, or 6	1 or 2, plus one of 3, 4, 5, or 6	1 or 2, plus one of 3, 4, 5, or 6	one of 1, 3, 4, 5, or 6	one of 1, 2, 3, 4, 5, or 6	-	-	1, plus one of 3, 4, 5, or 6

Zone 2 Required Upgrades for Trade-offs for Compliance Packages where Space Heating Equipment has a 90% AFUE or Higher

Trade-Off		Upgrades to the Compliance Packages (see Upgrades list below)												
		A	B	C	D	E	F	G	H	I	J	K	L	M
above grade min. wall insulation not less than RSI 3.52 (R-20)	any type of insulation	-	-	-	-	-	-	-	1 plus 7	1 plus 7	1 plus 7, or 2 plus at least two of 3, 4, 5, or 6	-	-	1 plus 7
	blown-in or spray foam insulation	-	-	-	-	-	-	-	1, plus one of 3, 4, 5, or 6	1, plus one of 3, 4, 5, or 6	1 or 2, plus one of 3, 4, 5, or 6	-	-	1, plus one of 3, 4, 5, or 6

Upgrades:

1 - the overall coefficient of heat transfer of the glazing is upgraded in accordance with Sentence 2.1.1.1.(8), in addition to an upgrade where it is required due to high fenestration to wall ratio
2 - the thermal insulation value in basement walls has a minimum RSI 3.52 (R-20)
3 - the thermal insulation value in a ceiling with an attic space is not less than RSI 10.55 (R-60)
4 - the minimum efficiency of the HRV is increased by not less than 8 percentage points
5 - the minimum AFUE of the space heating equipment is increased by not less than 2 percentage points
6 - the minimum EF of the domestic hot water heater is increased by not less than 4 percentage points
7 - the minimum EF of the domestic hot water heater is increased by not less than 8 percentage points

Note: Trade-offs involving Drain Water Heat Recovery units are located in Figure 13.30

Figure 13.29
Required Upgrades for Trade-offs where Space Heating Equipment has a 90% AFUE or Higher

(SB-12 2.1.1.2.)
(SB-12 2.1.1.3.)

Drain Water Heat Recovery (DWHR) Trade-Offs

Zone 1

DWHR Unit	Original	Trade-off
Any Unit	Above grade min. wall insulation RSI 3.87 (R-22)	Above grade wall insulation RSI 3.52 (R-20)
	Basement min. wall insulation RSI 3.52 (R-20)	Basement min. wall insulation RSI 2.11 (R-12)
	Glazing U-Value 1.6 W/(m²•K) max.	Glazing U-Value 1.8 W/(m²•K) max.
	Glazing U-Value 1.4 W/(m²•K) max.	Glazing U-Value 1.6 W/(m²•K) max.
	HRV min. 75% efficiency	HRV min. 55% efficiency
	Furnace min. 94% efficiency	Furnace min. 90% efficiency
46% min. efficiency	Above grade wall insulation RSI 4.23 (R-24)	Above grade wall insulation RSI 3.52 (R-20)
62% min. efficiency	HRV, any efficiency	no HRV, unless required by Section 9.32.

Zone 2

DWHR Unit	Original	Trade-off
Any Unit	Glazing U-Value 1.6 W/(m²•K) max.	Glazing U-Value 1.8 W/(m²•K) max.
	HRV min. 75% efficiency	HRV min. 55% efficiency
41% min. effficiency	Above grade min. wall insulation RSI 4.23 (R-24)	Above grade min. wall insulation RSI 3.87 (R-22)
	Glazing U-Value 1.4 W/(m²•K) max.	Glazing U-Value 1.6 W/(m²•K) max.
46% min. efficiency	Basement min. wall insulation RSI 3.52 (R-20)	Basement min. wall insulation RSI 2.11 (R-12)

Note: Only DWHR trade-offs are shown. Other trade-offs are outlined in Articles 2.1.1.2. and 2.1.1.3. Only the thermal performance of one of above grade walls, basement walls, or windows is permitted to be reduced for all permitted trade-offs.

Figure 13.30
Drain Water Heat Recovery Trade-Offs

(SB-12 2.1.1.2.)
(SB-12 2.1.1.3.)

Looking Back

Check for fire safety and sound control considerations in Chapter 6.

Check for Part 12 requirements for programmable thermostat and electronically commutated motors for furnaces, as well as duct sealing requirements in Chapter 11. Check for hot water pipe insulation requirements in Chapter 12.

Looking Ahead

Ensure that building envelope assemblies are capable of providing sufficient levels of thermal insulation and identify construction details for air and vapour barriers that may require special construction sequencing or materials.

Prescriptive Packages Additional Requirements

Additional requirements also apply to both climatic zones.

Enclosed unheated spaces separated from heated spaces by glazing may be considered to provide a thermal resistance to the separating assembly of RSI 0.16 (R0.9).

Log wall construction and post, beam and plank construction, regardless of climatic zone, are required to provide a minimum thermal resistance of RSI 2.1 (R12) for the total assembly. This value may be reduced to RSI 1.61 (R9.1) provided the thermal resistance of exposed roofs or ceilings is increased by an amount equivalent to the reduction. If log walls are machined square with a mean thickness of 150 mm (6"), fitted with tongue-and-groove or splined joints to control air leakage and the exposed roof or ceiling has an RSI value increased by 0.53 (R3), the minimum wall assembly thermal resistance does not apply. Log houses built with tongue-and-groove or splined joints are deemed to be in compliance with the air barrier requirements of the Code.

Cold rooms are considered part of the basement space if they are heated. If a cold room is unheated, it must be separated from the heated part of the building with insulation. All insulation requirements of the Code apply to cold rooms.

Performance Compliance

Supplementary Standard SB-12 permits the demonstration of a dwelling's energy efficiency through simulated annual energy performance. In order to comply using the performance path, a dwelling would need its energy consumption simulated by HOT2000 or other acceptable compliance software. Its simulated energy consumption would need to be less than or equal to the simulated consumption of a base case, namely, the same house using the same heating energy source, in the same location and equipped with the components from a prescriptive compliance package.

The simulations would need to assume an air leakage rate of 2.5 air change per hour (ACH) @ 50 Pa for detached homes and 3.0 ACH @ 50 Pa for attached homes.

The performance compliance path must be used when the window to wall ratio exceeds 22%. The base case would assume a 17% window to wall ratio where the fraction of windows on each house orientation is the same as the actual house.

When trading off the envelope insulation using the performance compliance method, the performance of the building envelope is not permitted to be reduced by greater than 25% compared to the chosen compliance package.

Acceptable simulation software includes HOT2000 v9.34 c or newer, or RESNET accredited Home Energy Rating System (HERS) software such as OptiMiser, EnergyGauge, Energy Insights, and REMRate.

Other Acceptable Compliance Methods

If the dwelling is in compliance with the technical requirements for NRCan's Energy Star for New Homes (ESNH), it is also considered to be in compliance with SB-12. This can be demonstrated by showing compliance with the Energy Star specification. Although registration in the Energy Star program is not required, registration and acquiring an ESNH label can provide assurance and enhanced confirmation that Energy Star is achieved.

Additions to Existing Buildings

There are two energy efficiency compliance options for additions to existing buildings. Additions can comply with the Compliance Packages for new buildings (See Figures 13.25 to 13.28), or they can comply with the Compliance Packages in Figure 13.31. These packages eliminate the necessity to comply with mechanical requirements. The same window to wall ratio provisions apply as new buildings, but the addition may be considered independently or in combination with the existing residence. One-storey sunrooms are addressed separately; while they are exempt from insulation requirements, more stringent U-values apply to glazing.

Compliance Packages for Additions to Existing Buildings

Component	Compliance Packages for Zone 1	Compliance Packages for Zone 2	Compliance Package for Electric Space Heating Zone 1 and 2
Ceiling with Attic Space (1) Minimum RSI-Value (R-Value)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space (1) Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor (1) Minimum RSI-Value (R-Value)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade (1) Minimum RSI-Value (R-Value)	4.23 (R24)	4.23 (R24)	5.46 (R31)
Basement Walls (1) Minimum RSI-Value (R-Value)	3.52 (R20)	3.52 (R20)	3.52 (R20)
Edge of Below Grab Slab Entire surface equal or less than 600 mm (23-5/8") below grade (1) Minimum RSI-Value (R-Value)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Slab equal or less than 600 mm (23-5/8") below grade or Heated Slab (1) Minimum RSI-Value (R-Value)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value (W/m²•K) (2)	1.8	1.6	1.6
Skylights Maximum U-Value (W/m²•K) (2)	2.8	2.8	2.8

Notes:
(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m² • K)/W.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m² • K). See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.
(3) The building need not conform to minimum efficiency requirements for HRV's, domestic hot water heaters and space heating equipment required in Article 2.1.1.2. or 2.1.1.3.

Figure 13.31
Compliance Packages for Additions to Existing Buildings (SB-12 2.1.1.10.)

14 INTERIOR FINISHES

This Chapter outlines acceptable methods for the installation of finishing materials.

This chapter will present information to supplement the requirements of the Code. Emphasis throughout the commentary is placed on good workmanship and long term durability.

The requirements for wall and ceiling finishes are presented, with floor finishing provisions following, to reflect the typical installation sequence.

KEY POINTS

Interior finishes must be designed and constructed with the following functions in mind:

- fire and sound control;
- minimize the adverse effects of drying and/or shrinkage of framing lumber and trusses;
- provide acceptable finished surfaces; and
- resist the adverse effects of water and moisture at specified locations.

INTERIOR WALLS & CEILING FINISHES

BUILDING CODE REFERENCES

DIVISION B

9.29.1.1. Fire Protection and Sound Control
9.29.2. Waterproof Wall Finish
9.29.2.1. Where Required
9.29.2.2. Materials
9.29.3. Wood Furring
9.29.3.1. Size and Spacing of Furring
9.29.3.2. Fastening
9.29.4. Plastering
9.29.4.1. Application
9.29.5. Gypsum Board Finish
9.29.5.1. Application
9.29.5.2. Materials
9.29.5.3. Maximum Spacing of Supports
9.29.5.4. Support of Insulation
9.29.5.5. Length of Fasteners
9.29.5.6. Nails
9.29.5.7. Screws
9.29.5.8. Spacing of Nails
9.29.5.9. Spacing of Screws
9.29.5.10. Low Temperature Conditions
9.29.6. Plywood Finish
9.29.6.1. Thickness
9.29.6.2. Grooved Plywood
9.29.6.3. Nails and Staples
9.29.6.4. Edge Support
9.29.7. Hardboard Finish
9.29.7.1. Material Standard
9.29.7.2. Thickness
9.29.7.3. Nails
9.29.7.4. Edge Support
9.29.8. Insulating Fibreboard Finish
9.29.8.1. Material Standard
9.29.8.2. Thickness
9.29.8.3. Nails
9.29.8.4. Edge Support
9.29.9. Particleboard, OSB or Waferboard Finish
9.29.9.1. Material Standard
9.29.9.2. Minimum Thickness
9.29.9.3. Nails
9.29.9.4. Edge Support
9.29.10. Wall Tile Finish
9.29.10.1. Tile Application
9.29.10.2. Mortar Base
9.29.10.3. Adhesives
9.29.10.4. Moisture Resistant Backing
9.29.10.5. Joints between Tiles and Bathtub

Looking Back

Check for fire safety and sound control considerations in Chapter 6.

Minimum Size and Maximum Spacing of Furring

Maximum Spacing of Furring mm (in)	Minimum Size of Furring mm (in)		
	Maximum Spacing of Furring Supports		
	Continuous Support	406 mm (16") o.c.	610 mm (24") o.c.
305 (12")	19 x 38 (1 x 2)	19 x 38 (1 x 2)	19 x 64 (1 x 3)
406 (16")	19 x 38 (1 x 2)	19 x 38 (1 x 2)	19 x 64 (1 x 3)
610 (24")	19 x 38 (1 x 2)	19 x 64 (1 x 3)	19 x 89 (1 x 4)

Figure 14.1
Minimum Size and Maximum Spacing of Furring (9.29.3.1.)

The installation and acceptability of finishes depends on the underlying structure upon which the finish is attached. The quality of the hidden structure is often as important to the quality of the finish as the choice of finish itself.

Interior finishes are often an integral part of the fire and sound control provisions of a building assembly. Reference should be made to Chapter 6 of this Guide to more fully understand this relationship.

Wood Furring

A wall or ceiling finish always looks better when it appears plane and even. Furring can help achieve this where wall or ceiling members are slightly out of line.

Wood furring is sometimes used for attachment of wall finishes. It may be used on concrete or wood frame walls and must be fastened with at least 51 mm (2") nails and screws of appropriate sizes. Figure 14.1 specifies the minimum size and maximum spacing of furring.

Gypsum Board

Single layer applications of gypsum board on wood framing or wood furring attached with screws or nails are discussed here. All other types of applications must conform with CSA A82.31, "Gypsum Board Application." Gypsum board materials must conform with CSA A82.27, "Gypsum Board", ASTM C1178 / C1178M, "Coated Glass Mat Water-Resistant Gypsum Backing Panel", or ASTM CSA1396/ C1396M "Gypsum Board". The required spacing of supports for gypsum board is shown in Figure 14.2. Gypsum board that supports insulation must be at least 12.7 mm (1/2") thick. Where insulation levels are high, or when ceiling boards are being installed in late fall and winter and insulation is not in place, moisture may condense and freeze behind the board. A 15.9 mm (5/8") drywall is often recommended as best practice to prevent drywall sagging. Length of fasteners must conform to Figure 14.3. An exception to these requirements can be made where an assembly is subjected to a fire test which shows that the length of fastener is adequate to maintain the fire rating. Nails must conform to CSA B111 "Wire Nails, Spikes and Staples." Screws must conform to ASTM C1002, "Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs."

Maximum Spacing of Supports for Gypsum Board

Gypsum Board Thickness, mm (in)	Orientation of Board to Framing	Maximum Spacing of Supports o.c., mm (in)		
		Walls	Ceilings Painted Finish	Ceilings Water Based Texture Finish
For Gypsum Board products conforming to standards A - I and K				
9.5 (3/8")	parallel	-	-	-
	perpendicular	406 (16")	406 (16")	-
12.7 (1/2")	parallel	610 (24")	406 (16")	-
	perpendicular	610 (24")	610 (24")	406 (16")
15.9 (5/8")	parallel	610 (24")	406 (16")	-
	perpendicular	610 (24")	610 (24")	610 (24")

Gypsum Board Standards

A	CAN/CSA-A82.27M "Gypsum Board"
B	ASTM C1178/C1178M "Coated Glass Mat Water-Resistant Gypsum Backing Panel"
C	ASTM C1396/C1396M "Gypsum Board"

Figure 14.2
Maximum Spacing of Supports for Gypsum Board (9.29.5.2.) (9.29.5.3.)

Minimum Fastener Penetration Into Wood Supports

Required Fire-Resistance Rating of Assembly	Walls mm (in)		Ceilings mm (in)	
	Nails	Screws	Nails	Screws
Fire resistance rating not required	20 mm (13/16")	15 mm (5/8")	20 mm (13/16")	15 mm (5/8")
45 min	20 mm (13/16")	20 mm (13/16")	30 mm (1-3/16")	30 mm (1-3/16")
1 h	20 mm (13/16")	20 mm (13/16")	45 mm (1-3/4")	45 mm (1-3/4")
1.5 h	20 mm (13/16")	20 mm (13/16")	60 mm (2-3/8")	60 mm (2-3/8")

Note:
Refer to SB-2 2.3.9. for detail on membrane fastening, or details in SB-3 for specified assemblies, or details related to listed/tested assemblies

Figure 14.3
Minimum Fastener Penetration Into Wood Supports (9.29.5.5.)

Spacing of nails for single layer applications must be not more than 180 mm (7-1/8") o.c. for ceilings and not more than 200 mm (7-7/8") o.c. for vertical wall frames. Nails may be spaced in pairs about 50 mm (2") apart at 300 mm (11-3/4") o.c. The nails along the top row on a wall must be placed at not more than 200 mm (7-7/8") from the intersection of the ceiling and wall. Nail heads must not be less than 10 mm (3/8") from the edge of a gypsum board. Nails must be driven without nail heads puncturing the finish paper. For rated assemblies refer to SB-2, SB-3, or listed (fire tested) assemblies for details.

Screw spacing must be at most 300 mm (11-3/4") o.c. on ceiling and wall supports or they may be 400 mm (15-3/4") o.c. where vertical supports are spaced not more than 406 mm (16") o.c. For walls, where gypsum board is required to provide bracing, lateral support or fire protection (see SB-2 or SB-3 as applicable), screws shall be spaced not more than 300 mm (11-3/4") o.c. on vertical wall supports and the top and bottom plates. The purpose of fire protection may also be addressed based on the fire resistance rating determined in the Supplementary Standard SB-2 or SB-3 in the Code. Note that screws should also be at least 10 mm (3/8") from the edge of the board and heads should not puncture the surface paper. See Figure 14.4 and 14.5.

Ceiling sheets may be supported on the wall sheets around the ceiling perimeter instead of screwing and nailing at that location.

Heat must be provided to maintain a temperature of at least 10°C (50°F) 48 hours before taping and after finishing.

Regular drywall differs from moisture resistant drywall because the covering is resistant to water. However, it is still susceptible to water damage. If water is a concern, cement board should be used because it is not susceptible to water.

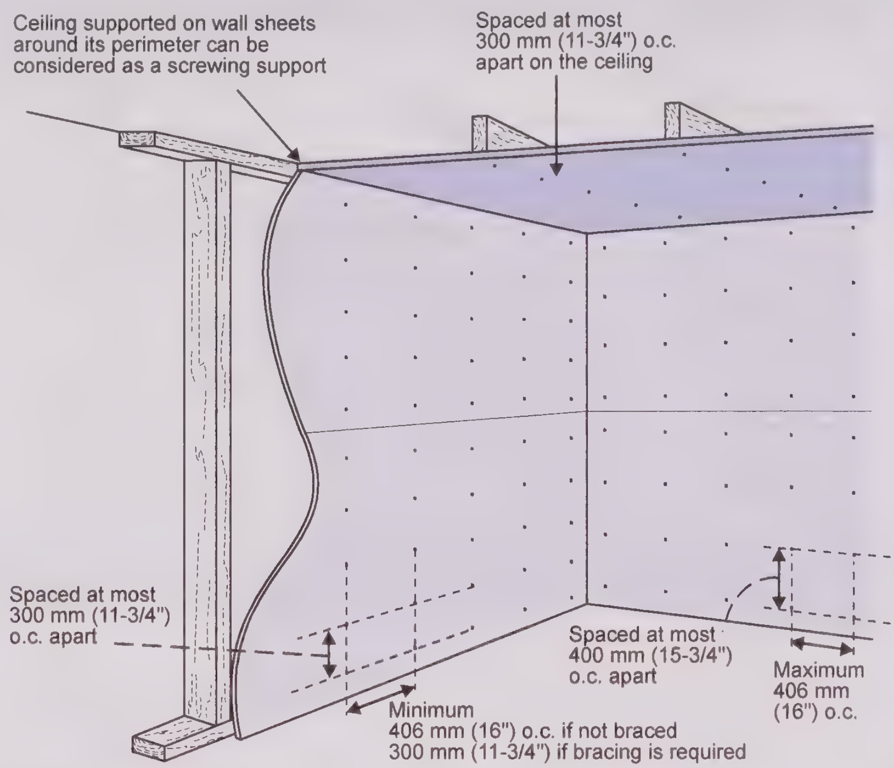


Figure 14.4
Screw Spacing for Gypsum Board (9.29.5.9.)

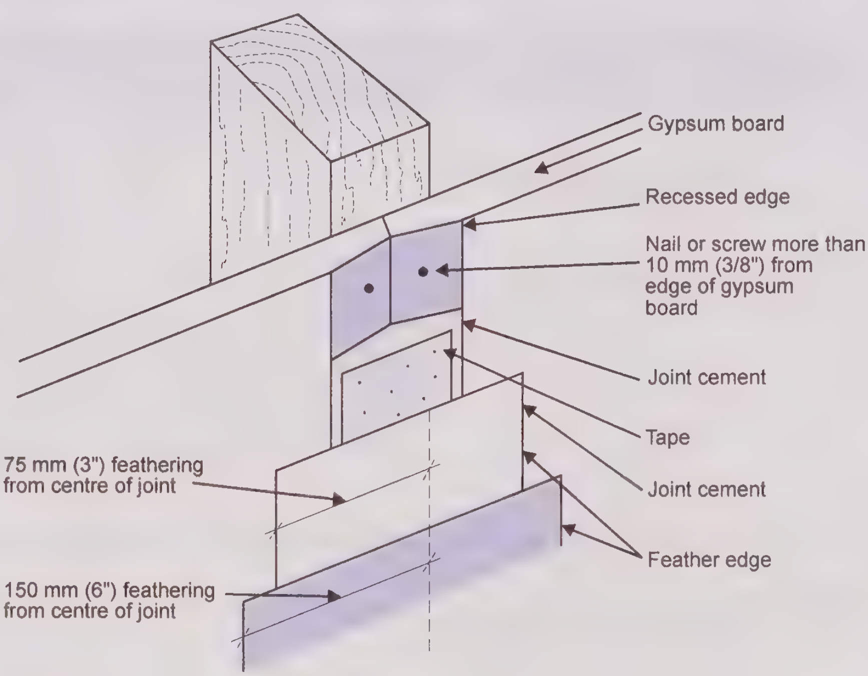


Figure 14.5
Finishing Gypsum Board (9.29.5.)

Moisture

Installation of Gypsum Board

The finish appearance and durability of gypsum board joints is directly related to the quality of workmanship used in installation. Pre-folding mesh tape when applied to inside corners and proper screwing of outside corner beads can make a difference.

Regular gypsum board should not be used if it will be exposed to high levels of moisture.

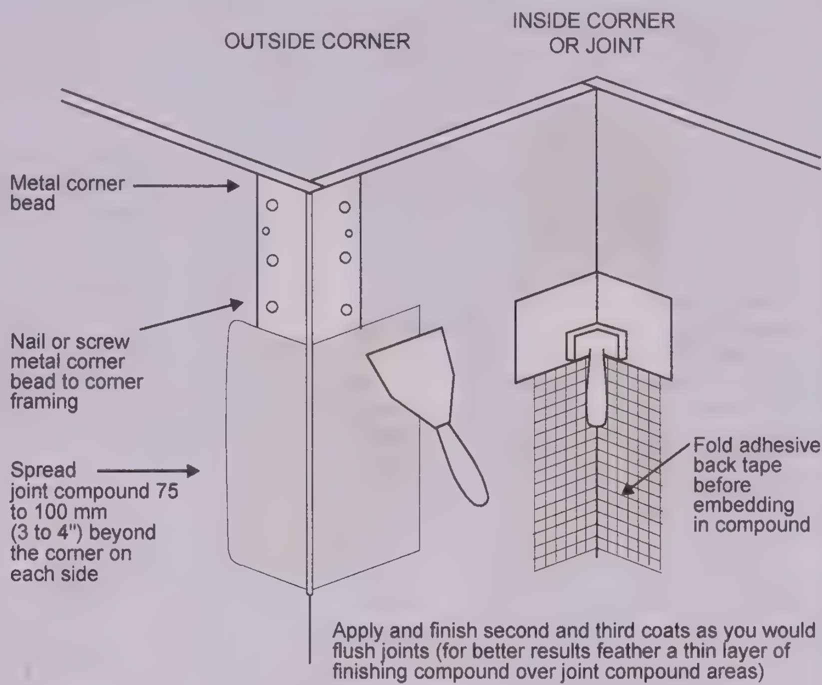
The products used in application of gypsum finishing must conform with proper storage requirements set out by the manufacturers. Keep gypsum boards flat and horizontal on a continuous surface away from potential sources of moisture. Joint compound must be kept in a dry location. There are various types of joint compound, each with different attributes, for example drying times. Care should be taken to review the attributes and manufacturer instructions before use.

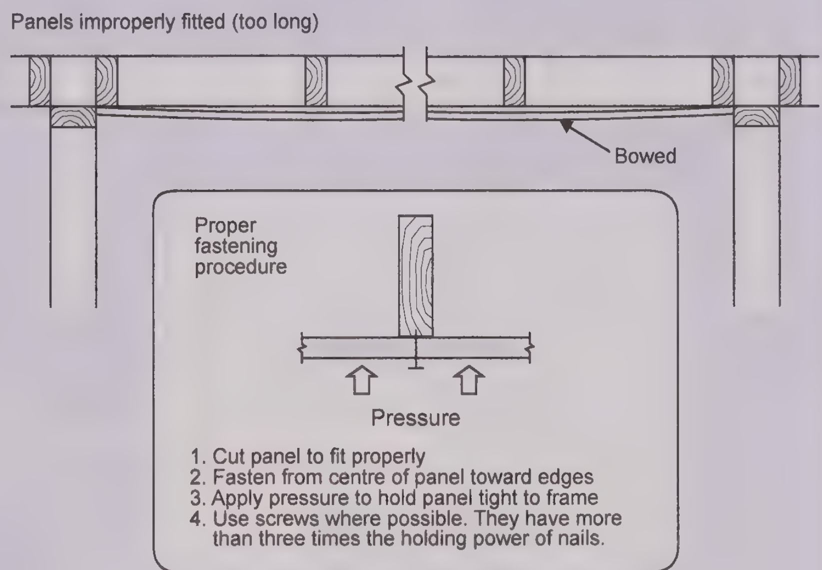
Reasonable temperature and humidity levels as well as good ventilation are essential for good application of joint compound. Protection from outside weather is important. Unpainted drywall will discolour from extended exposure to sunlight making final decoration difficult. Exposure to rain may cause irreparable damage.

Boards that are cracked or have chipped edges or corners should be discarded - sound portions of damaged board can be salvaged and used where suitable.

Looking Back

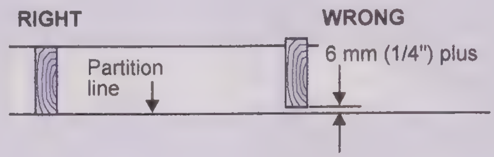
Chapter 13 of this Guide details vapour barriers, air barriers, and insulation requirements.

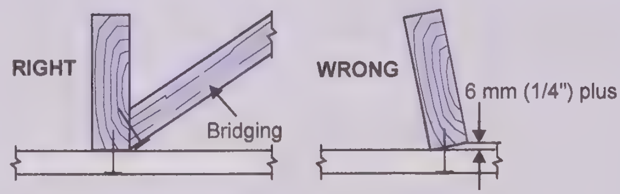


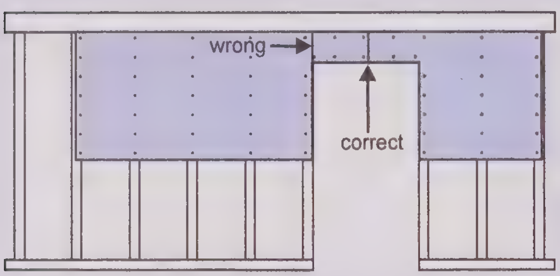


All fasteners must be secure and tight. Stripped fasteners should be removed and re-applied close to the original location. Never force an oversized board onto a frame as it will force the board to bow outward and make the innermost fasteners more difficult to secure. Centre nails will often puncture the paper in this situation. Cut the board to the proper size and reinstall.

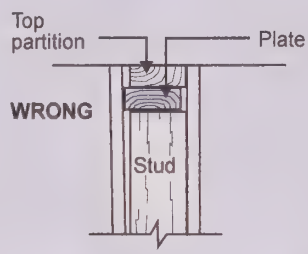
The top plates and studs that are out of line may cause the gypsum board to bow or wave. Fastener heads may puncture the finish paper or pull out over time. It is recommended that warped, twisted or bowed framing members not be used, or be corrected. Where problems exist, shims may be used to help correct the framing mistakes.



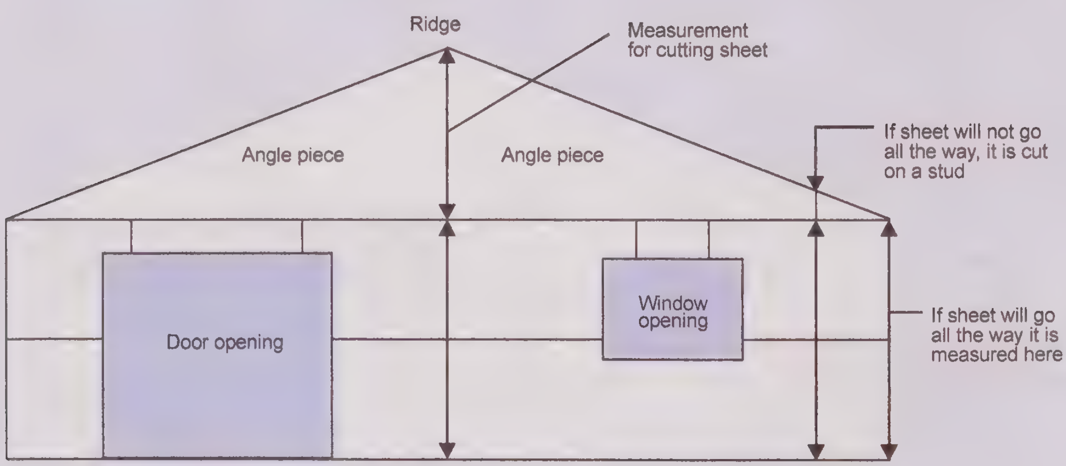




Locate board joints away from corners of openings



Align all twisted members before applying drywall

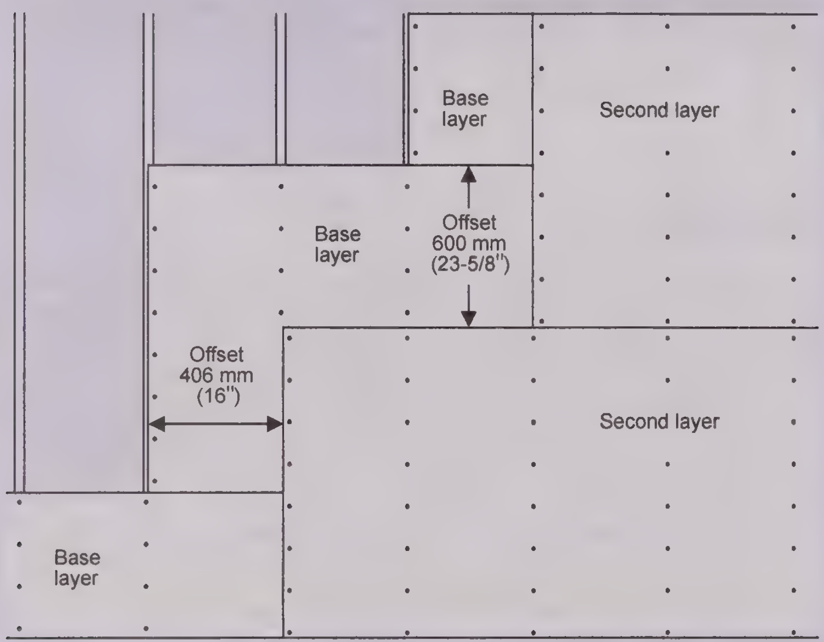


Locations where measurements are made when cutting angle pieces for a double angle ceiling

Wood frame walls can move and settle over time. Cracking of gypsum board joints can occur over openings. The diagrams show proper installation of boards that will help prevent this.

Puncturing of facing paper from careless nailing or screwing results in a fastener which does not have the proper hold on a board. These fasteners should be removed and relocated in close proximity to the hole. Nails can loosen when drywall is being installed on the other side of a wallframe that has already been drywalled. All fasteners should be checked before joint compound is applied.

An application of double layered drywall requires that the first and second layers are each applied with the minimum required nailing as a single layer application. The layers should be staggered at least 150 mm (5-7/8") both vertically and horizontally. In rated assemblies refer to SB-2 or SB-3 as applicable.



Finishing Gypsum Board Joints

The following simple procedures can help prevent many of the problems associated with the finishing of gypsum board joints. Joint compound should be applied into the recessed space of the board to form a base for the adhesive back tape which is carefully embedded. Once this first application is dry, a second coat of compound is then applied and the edges are feathered out level with the board. A third coat of joint compound may be applied once the second coat is dry.

Blisters in tape can be caused by overly thin compound under the tape because of poor application or because of excessive tool pressure forcing compound out. Poor tape embedment can also cause this problem. The blistered area should be opened up by slitting the tape and filling with compound. When dry the area should be sanded level.

All nail holes must be filled with compound. It is crucial to remove all air pockets and bubbles when applying compound to prevent sagging or blisters. The objective is to make the surface smooth and continuous so that the joints in the boards are undetectable. Sanding helps prevent crowns, mounds, or ridges in the finished surface of the drywall that results from joint compound on joints or nail holes. Oversanding may cause paper to fluff.

After joint treatment, straight, narrow cracks along edges of the tape can occur. This can result from many causes including: too rapid drying of compound associated with hot, dry weather or excessive drafts; over dilution of joint compound or improper compound; excessive compound under the tape; and failure to apply a skim coat over the tape. These cracks are often not detected until the drywall is painted or decorated. Carefully examine the drywall before this stage commences. Repair all imperfections before painting or decorating.

Nail Popping - The Biggest Problem in Drywall Failure

Moisture is the major culprit in the failure of nails in the installation of gypsum board. As wood dries it tends to shrink. The drying is accelerated during the first heating season. Longer nails tend to pop further than short nails. Smooth nails tend to pop more than screws.

Proper practice for nailing helps to prevent nail popping and involves using nails which are as short as possible and which grip the wood to prevent pullout. Nails that are 31 mm (1-1/4") long with annular rings are short enough to minimize the push out of the shrinking wood and have good pull out capacity because of the annular rings.

Screws and double nailing can be used to pull boards flush with framing and further reduce the likelihood of nail pop-out. The use of adhesives and resilient furring are becoming alternatives to conventional drywall installation. These alternatives can be examined to determine their economic feasibility depending on the severity of the problem in a given region.

Truss Uplift

Truss uplift is the result of an internal upward stress within a truss. It occurs typically in winter when the top chords are exposed to colder temperatures than the bottom chord which is generally covered with attic insulation. Wood shrinkage depends on the relative humidity that the wood is exposed to. Bottom and top chords can be exposed to conditions which differ dramatically in winter, with the top exposed to higher relative humidity. The result is that the bottom chord tends to shrink relative to the top chord. The bottom chord can bow upward because of this differential shrinkage depending on the climate, truss design and wood used.

Some lumber is more prone to this problem. Juvenile wood from the core of a tree, compression wood which is from the down side of a tree that was on a hill, and of a wood with a high slope in its grain are most susceptible. Every winter these types of lumber cause truss uplift problems which can damage interior finishes.

Trusses with greater slopes have less damage resulting from uplift than those trusses with smaller slopes.

Although unsightly, truss uplift rarely has structural consequences.
The practices that follow have been developed to help minimize the damage caused to interior finishes.

Accommodating Truss Uplift

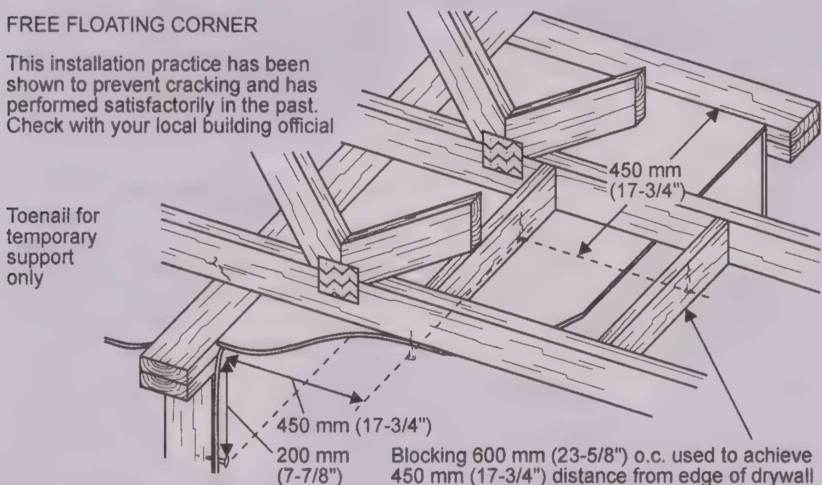
A truss that cambers upward should not be selected as carpenters will often force the base chord down by nailing it to interior partitions. If a truss is cambered upward naturally it should be shimmed to the interior partition. The forces involved in truss uplift are tremendously strong. If a partition wall is securely nailed to the base of a truss, the whole partition may lift with the truss resulting in damage at the base of the wall.

The moisture content of wood should always be as low as possible during construction especially when the interior finishes are being installed. The air/vapour barrier must be installed as a continuous impermeable obstruction that will prevent moisture within the home from increasing the moisture content in the attic. Refer to Chaper 13 of this Guide.

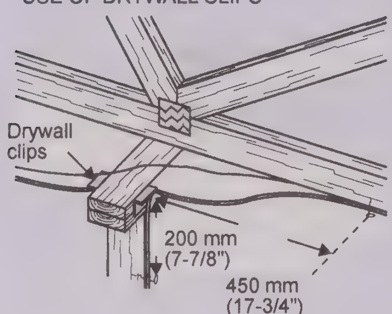
There are a number of methods to prevent damage of interior finishes from truss uplift. Drywall is the most common finish that is affected. The illustrations that follow describe some of the methods that may be used to minimize problems. The objective of most of the methods described below involves allowing the truss to move upwards by attaching the edge of the finish to the partition instead of the truss to maintain the corner. Allowing the crack to occur and installing a cornice for cover is an alternative to these methods and is presented in the final illustration. The cornice is nailed to the ceiling after the wall finish is applied so that as the ceiling finish lifts up with the truss, the large crack that occurs is covered and unnoticeable.

FREE FLOATING CORNER

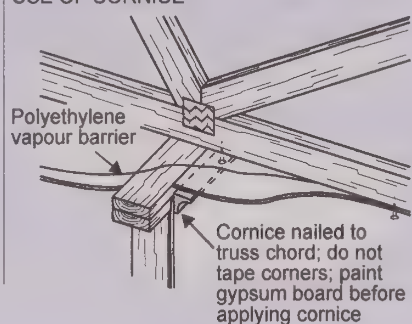
This installation practice has been shown to prevent cracking and has performed satisfactorily in the past. Check with your local building official



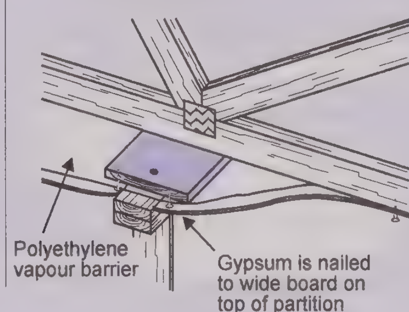
USE OF DRYWALL CLIPS



USE OF CORNICE



USE OF WIDE BOARD



Plastering

Lath and plaster must be applied in conformance with CSA A82.30, "Interior Furring, Lathing and Gypsum Plastering." Where applicable in rated assemblies, refer to SB-2 1.7.2, 2.2.1, 2.8.5.

Plaster may be applied to masonry or wood-frame construction. Wall and ceiling assemblies must be rigid and plane with minimal deflection. Plaster may be applied directly to masonry provided that the surface is porous and rough and, most importantly, clean of grit, dust, oil, or other materials that may jeopardize the durability of the finish. Otherwise, furring and metal lath must be used.

Wood-frame construction requires that a lath be applied for the support of the plaster. Lath may be metal (expanded metal or wire lath) or gypsum wallboard that has a surface of porous fibrous paper that provides for adhesion of the plaster. Refer to Figures 14.6 and 14.8.

Plaster is a cementitious material comprised of gypsum cement, lime, water, fibres, and sand. Plastering over a metal lath normally involves a three coat application. Metal lath joints must lap about 12.7 mm (1/2") on sides and 25 mm (1") on ends. Corners must be lapped. The sides and ends of the lath must be attached by a maximum of 150 mm (5-7/8") o.c. on supports. Refer to the extract from CSA Standard A82.30 Clauses 4.8.1 to 4.8.3 below.

Two coat plaster applications are more commonly used on gypsum laths. Gypsum lath should be attached in conformance with the requirements for gypsum wallboard nailing or screwing. Sheets are laid lengthwise across supports.

Refer to Figures 14.6 and 14.8. All corners and edges must be reinforced with metal lath. See Figure 14.7.

Excerpts From CSA A82.30M
Interior Furring, Lathing, and Gypsum Plastering

4.8 Basecoat Plaster Application

4.8.1 Three coat plaster application shall be used on the following constructions:

(a) Metal lath;

(b) 12.7 mm (1/2") gypsum lath attached to horizontal supports spaced more than 400 mm (16") o.c.;

(c) Gypsum lath on ceilings attached by clips providing edge support only; and

(d) Over 9.5 mm (3/8") thick lath gypsum lath where a vapour barrier is used adjacent to the back of the lath.

4.8.2 Three Coat Work

4.8.2.1 Scratch (first) coat shall be applied with sufficient pressure to form good full keys on metal lath, and a good bond on gypsum lath or masonry. Sufficient materials shall be used to cover the face of the lath and to allow for scratching or cross-raking.

4.8.2.2 Brown (second) coat shall be applied after the scratch coat has set firm and hard, and shall be brought out to the grounds, straightened to a true surface without the application of water and left porous and sufficiently rough to provide mechanical bond for the finish (third) coat.

Note: To ensure full plaster thickness, plaster screeds should be applied to the scratch coat prior to the application of the brown coat.

4.8.3 Two Coat work

4.8.3.1 The base (first) coat shall be applied with sufficient pressure and material to form a good bond on the gypsum lath or masonry and to cover well. Then, before the plaster has set, and without raking its surface, material of the same proportion shall be doubled back to bring the plaster out to thickness. Straighten to a true surface, without the application of water, and roughen to receive the finish coat.

Explanatory Note
This is an excerpt from CSA A82.30, and does not reflect the stud spacing referenced in the Code: 305 mm (12"), 406 mm (14"), and 610 mm (16") o.c. The Code requirements for stud spacing supercedes the standard.

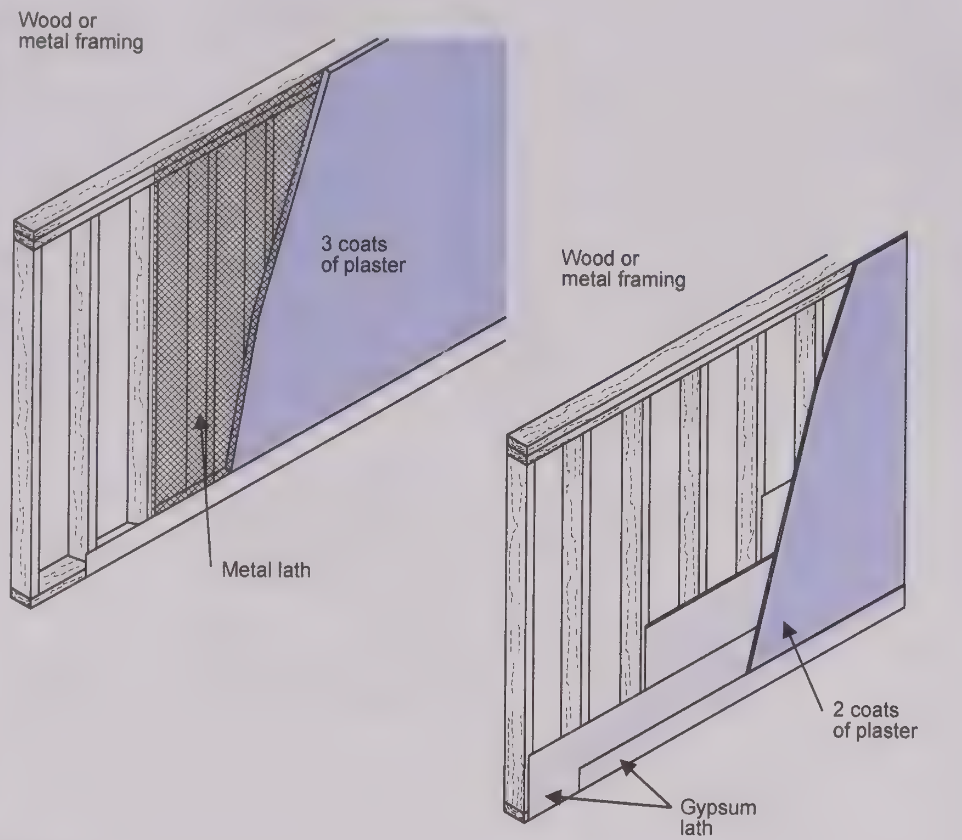
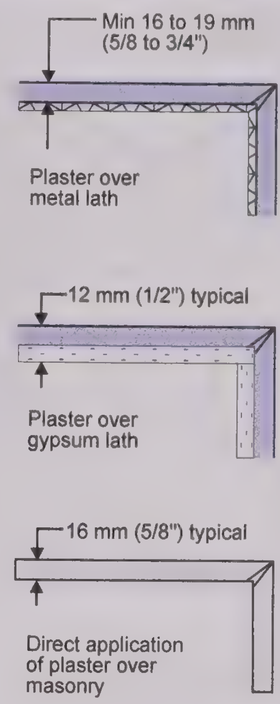


Figure 14.6
Plaster Over Wood Framing



Note: Finish coat must be min 1.5 to 3 mm (1/16 to 1/8")

External Corner Conditions

(9.29.4.1.)

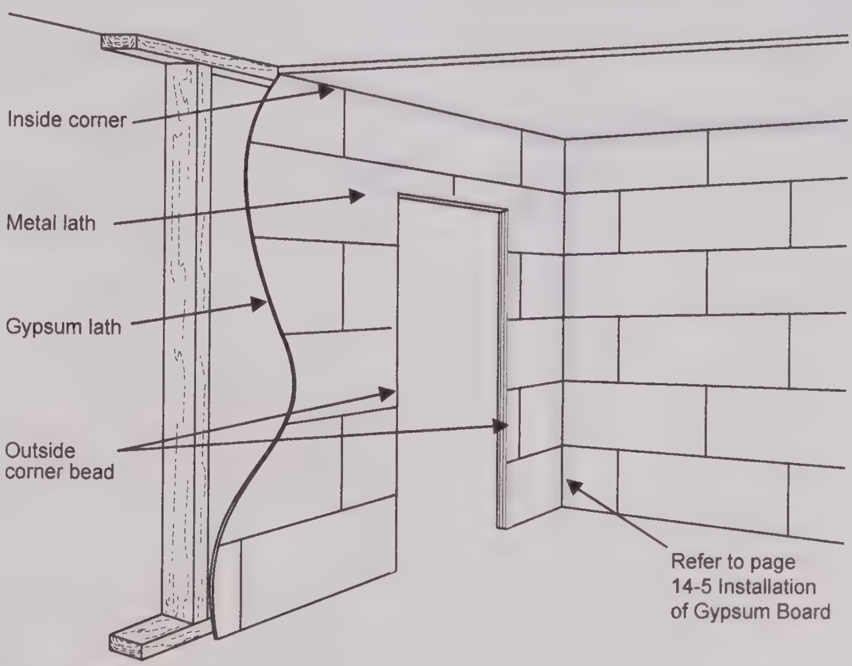


Figure 14.7
Reinforcement of Plaster

(9.29.4.1.)

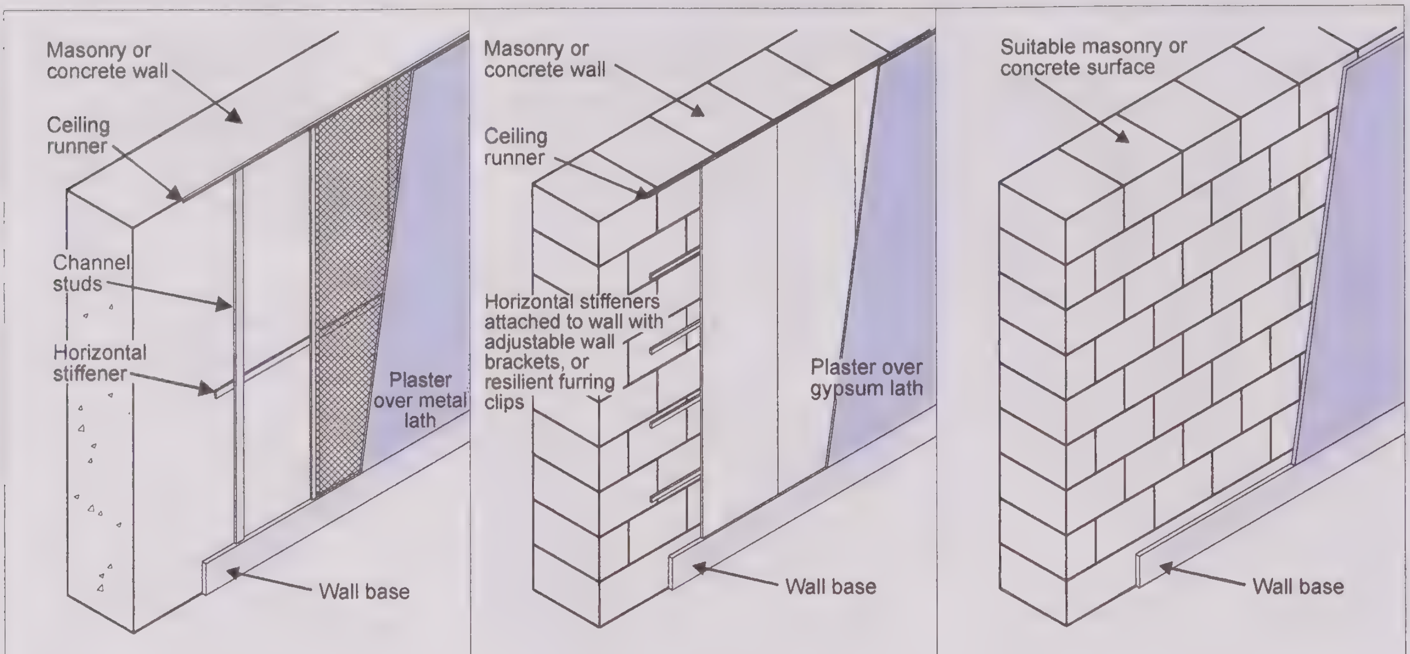


Figure 14.8
Plaster Over Masonry Walls

(9.29.4.1.)

Excerpts From CSA A82.30

3.16 Application of Gypsum Lath to Framing Supports

3.1.6.1 Gypsum lath shall be applied with long dimension perpendicular to framing supports and with lath face exposed to receive the plaster. Butt all joints and stagger end joints in alternate course. Position the lath over and under openings so that end joints do not occur over the sides of the openings.

3.16.2 Gypsum lath shall be attached with suitable fasteners in accordance with Clause 3.4. For nails, screws, or staples, space fasteners 125 mm (5") o.c. where supports are 400 mm (16") o.c., and not over 100 mm (4") o.c. where supports are 600 mm (2') o.c. (12.7 mm (1/2") lath only), and not less than 9.5 mm (3/8") from ends and edges. Drive fasteners flush with face of lath.

3.16.3 Corners of openings shall be reinforced by installing 150 x 450 mm (6" x 18") strips of diamond mesh metal lath diagonally across corners immediately above and below such openings. Staple the strips to the lath only using staples with maximum 9.5 mm (3/8") leg.

3.16.4 Interior corner reinforcement shall be provided at all interior angles by stapling metal cornerite to the lath only using staples with maximum 9.5 mm (3/8") leg.

3.16.5 External corners shall be protected by cornerbeads which shall serve to establish grounds for the plaster also. Attach securely to assure proper alignment during plastering.

3.17 Application of Metal Lath to Framing Supports

3.17.1 Metal lath shall be applied with the long dimension of the sheet perpendicular to framing supports and ends of sheets offset from adjoining sheets where possible. Except for suspended ceilings or where plaster stops are used to provide perimeter relief at the wall-ceiling angle, the lath shall be installed on the ceiling first and the sheets bent down to extend 150 mm (6") down the walls or other vertical surfaces. Application of diamond mesh lath shall be started on a support one space removed from a corner or angle and be bent into or around the corner. Ribbed lath shall be butted at internal angles and the joining covered with metal cornerite wire tied to the lath. End laps shall occur over supports where practical, but if occurring between supports the end laps shall be laced or tied together with 1.2 mm tie wire.

3.17.2 Fasteners shall be in accordance with Clause 3.4 and shall be spaced not over 150 mm (6") o.c. along supports.

3.17.3 Rib lath shall be applied with ribs facing framing supports and the outer ribs of ribbed lath shall be nested at the side and lapped 25 mm (1") at ends. Diamond mesh lath shall be lapped 13 mm (1/2") at the sides of sheets and 25 mm (1") at ends. Side laps shall be secured to all supports and tied between supports at intervals not over 150 mm (6").

3.17.4 Exterior vertical corners shall be protected by cornerbeads which shall also serve to establish grounds for the plaster. Attach securely to assure proper alignment during plastering.

3.17.5 Base screeds, plaster stops, casing beads, and other trim shall have expanded or perforated flanges or clips shaped to permit complete embedment in the plaster.

4.14 Application of Finish Coats

4.14.1.1 The base coat shall be applied to a surface dry basecoat or to a semi-green basecoat which has been evenly wetted, brushed, or sprayed. The use of excessive water shall be avoided in the application of all types of finish coats.

4.14.1.2 Where the plaster finish is flush with metal base, door bucks, or metal window frames, etc., the plaster finish shall have a V-groove finish at such intersections.

4.14.2 Application Method

4.14.2.1 Gypsum-lime putty trowel finish shall be scratched in thoroughly, double-backed, and filled out to a true, even surface. The thickness shall be 1.5 to 3 mm (1/8 - 1/4"). The finish shall be well troweled, with water, to a smooth finish, free from blemishes or irregularities. Continue troweling until finish coat sets.

4.14.2.2 Sand float finishes shall be scratched in thoroughly with a trowel to an even surface and then floated (wood, carpet, cork, rubber, or other type floats, depending upon the texture desired), to a true, even surface, free from slick spots or other blemishes.

4.5 Plaster Thickness

Plaster shall be of the following thickness when measured from the face of the plaster base the face of the finished plaster surface (allowing approximately 1.5 to 3 mm for the finished coat):

(a) Metal lath – 16 mm minimum;
(b) Gypsum lath – 13 mm minimum;
(c) Unit masonry – 16 mm minimum;
(d) Monolithic concrete:
  (i) Walls – 16 mm minimum;
  (ii) Ceilings – 10 mm maximum;
  (iii) Where greater thicknesses are required, metal lath shall be firmly attached to the concrete prior to the application of plaster;
(e) Solid plaster partitions – See Clauses 3.7.2. and 4.10.

Explanatory Note
This is an excerpt from CSA A82.30, and does not reflect the stud spacing referenced in the Code: 305 mm (12"), 406 mm (14"), and 610 mm (16") o.c. The Code requirements for stud spacing supercedes the standard.

Plywood And Hardboard Finishes

Plywood thickness must conform to Figure 14.9. Hardboard must conform to CAN/CGSB 11.3M, "Hardboard". The thickness of hardboard must be at least 3 mm (1/8") when supported continuously, 6 mm (1/4") when supported on framing not greater than 406 mm o.c. (16"), and 9 mm (3/8") when supported on framing not greater than 610 mm o.c. (24").

Grooved plywood finished for interior use must not have its grooves extend through the face ply or the plies beneath it unless the groove is supported by furring or framing. Refer to Figure 14.10 for exception.

Plywood and hardboard finishes must be nailed with finishing or casing nails at least 38 mm (1-1/2") long, spaced not more than 150 mm (5-7/8") o.c. on the edges and 300 mm (11-3/4") o.c. on intermediate supports. Plywood may be stapled provided that fasteners provide equivalent performance. The user may be required to demonstrate that, if staples are used, they are indeed equivalent.

Furring or framing support must be provided for all edges and joints in hardboard and plywood finishes. Refer to Figure 14.11.

Minimum Thickness of Plywood Interior Finish

Maximum Spacing of Supports mm (in) o.c.	On Supports with no Horizontal Blocking, mm (in)	On Supports with Blocking at Vertical Intervals not Exceeding 1.2 m (3' 11"), mm (in)
406 (16")	4.7 (3/16")	4.0 (5/32")
610 (24")	8.0 (5/16")	4.7 (3/16")

Figure 14.9
Minimum Thickness of Plywood Interior Finish (9.29.6.1.) (9.29.6.2.)

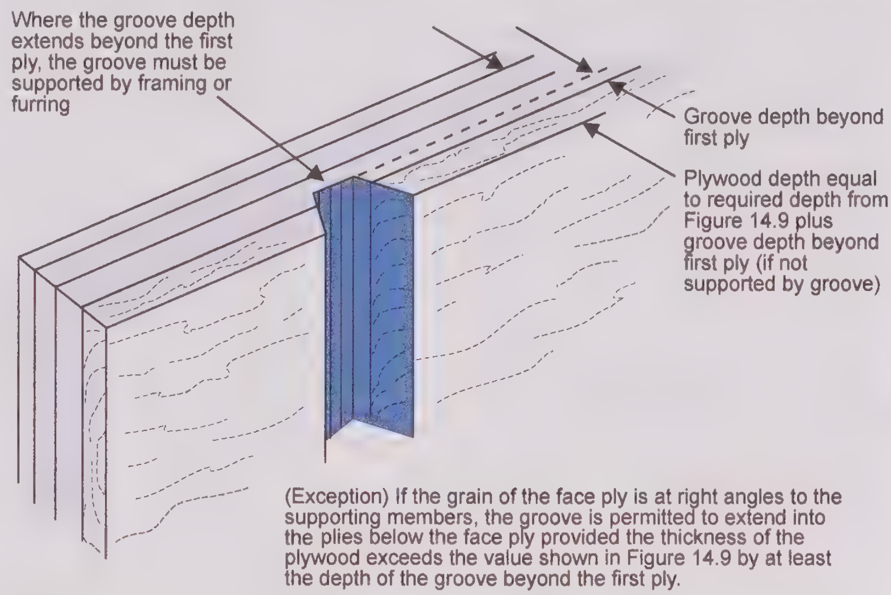


Figure 14.10
Grooved Plywood (9.29.6.2.(2))

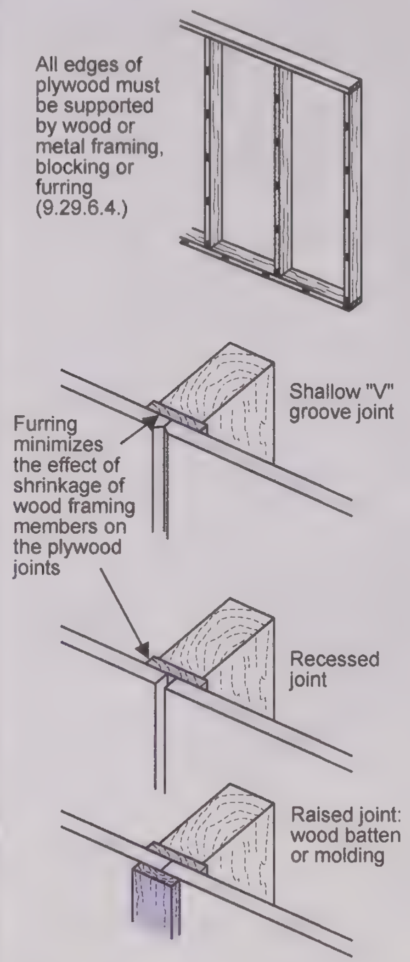


Figure 14.11
Plywood Edge Support (9.29.6.4.)

Insulating Fibreboard Finishes

Insulating fibreboard must comply with CAN/ULC-S706 "Wood Fibre Thermal Insulation for Buildings." Sheets must be at least 11.1 mm (7/16") thick when supported on not more than 406 mm (16") o.c. spaced supports. Fibreboard tile must be at least 12.7 mm (1/2") thick on supports at most 406 mm (16") o.c.

Nailing of fibreboard sheets requires 2.6 mm (3/32") shank diameter casing nails or finishing nails that must penetrate supports at least 20 mm (13/16"). Nails must be spaced not more than 100 mm (4") o.c. on edge supports and not more than 200 mm (7-7/8") o.c. on intermediate supports. All edges must be supported by framing, furring, or blocking.

Particleboard, Waferboard, or OSB Finishes

Particleboard finishes must conform to ANSI A208.1, "Particleboard, Mat-Formed Wood" Waferboard and OSB finishes must conform to CAN/CSA-O.325 "Construction Sheathing" or CSA O437.0 "OSB and Waferboard."

Waferboard and OSB that are graded R-1 and O-1 and all particleboards must be at least 6.35 mm (1/4") thick on not more than 406 mm (16") o.c. spaced supports or 610 mm (24") o.c. supports where blocking support is provided at mid wall height. These boards must be least 9.5 mm (3/8") thick on not more than 610 mm (24") o.c. spaced supports. OSB graded O-2 must conform to the table shown in Figure 14.9 except that the boards may be of any thickness when supported by continuous backing. In addition, OSB conforming to CAN/CSA-O325.0 "Construction Sheathing" must meet the minimum panel mark as required by Article 9.29.9.2. of the Code.

Nailing of any of these board finishes requires finishing or casing nails at least 38 mm (1-1/2") long spaced not more than 150 mm (5-7/8") o.c. on the edges and 300 mm (11-3/4") o.c. on intermediate supports. All edges of these boards must be continuously supported with furring, framing, or blocking.

Wall Tile Finishes

Wall finishes must be waterproof in certain areas of bathrooms. Shower stalls must have waterproof finishes from floor level to at least 1.8 m (5' 11") high. Waterproof finishes must be provided to at least 1.2 m (3' 11") above the top of a bathtub rim that has a shower nozzle and to at least 400 mm (15-3/4") above one that does not (see Figure 14.12).

Materials that may be used for waterproof finishes include ceramic, plastic, or metal tile, sheet vinyl, tempered hardboard, laminated thermosetting decorative sheets or linoleum.

Ceramic tile must be set in a mortar base or applied with an adhesive. The Code outlines provisions for the mortar base: a mortar base of cementitious material must consist of 1 part Portland cement to not more than 1/4 part lime by volume. The cementitious material shall be mixed with at least 3 parts of and not more than 5 parts of sand aggregate for 1 part of cement by volume. Ceramic tile applied to a mortar base requires that the mortar be applied onto a metal lath or masonry and the tiles be soaked and applied firmly so that mortar will fill the joints between the tiles so they can be easily tooled to a flush finish while the mortar is wet. Refer to Figure 14.13.

Joints between bathtubs and tiles must be caulked and sealed using materials that conform to CAN/CGSB-19.22-M, "Mildew Resistant Sealing Compound for Tubs and Tile." Use water resistant gypsum board around areas of excessive moisture and dampness to minimize deterioration.

Refer to Figure 14.14 for examples of sealing around shower pans and bathtub rims.

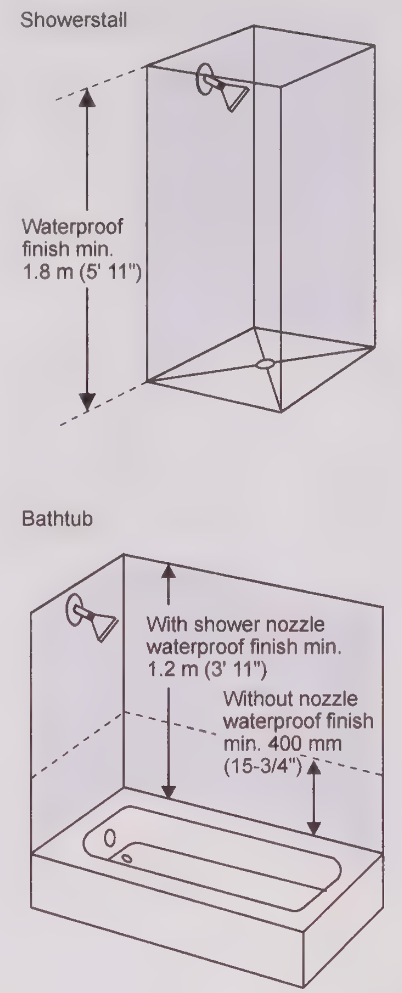


Figure 14.12
Height of Waterproof Finishes (9.29.2.1.)

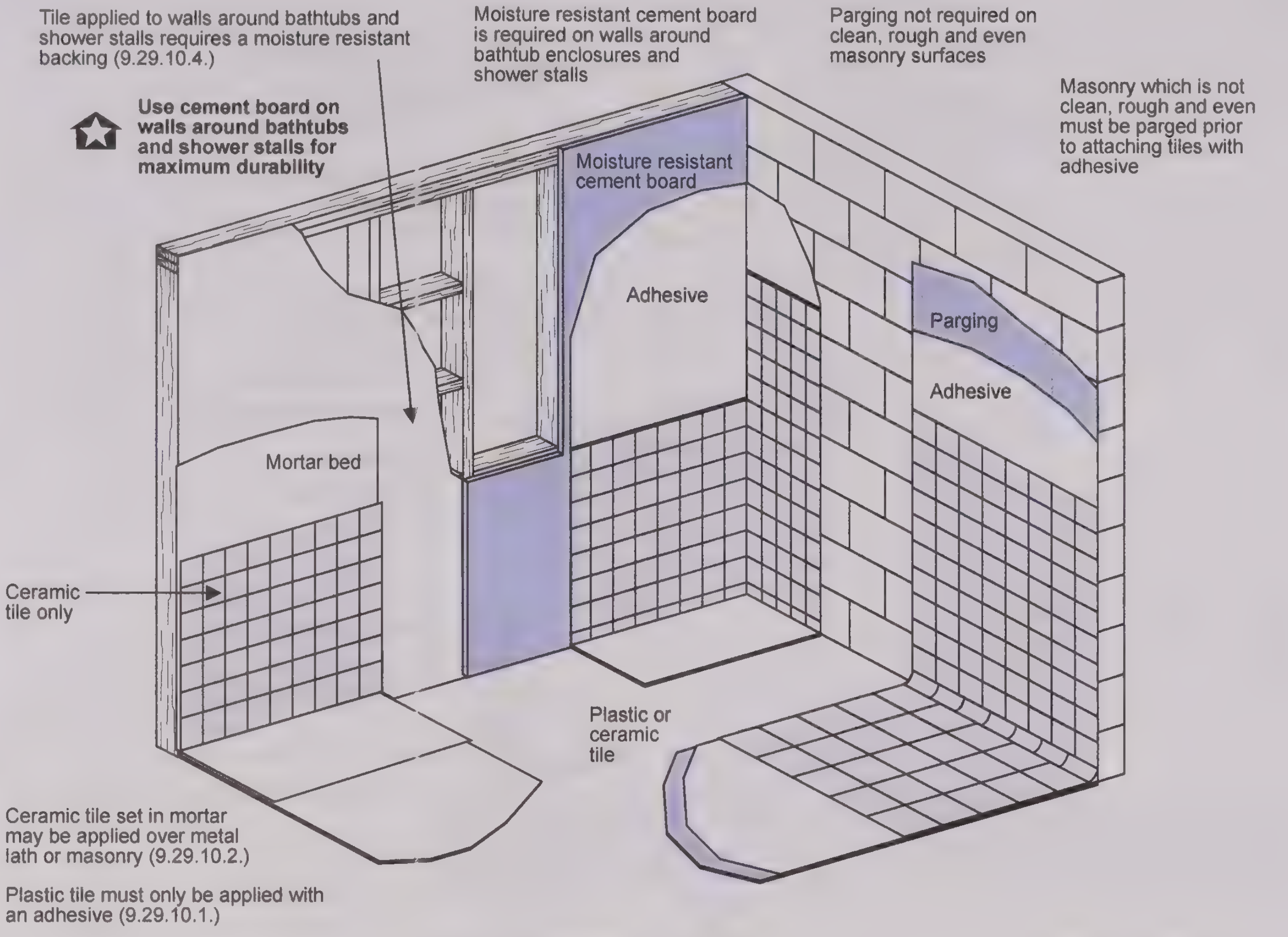


Figure 14.13
Setting Ceramic Tile

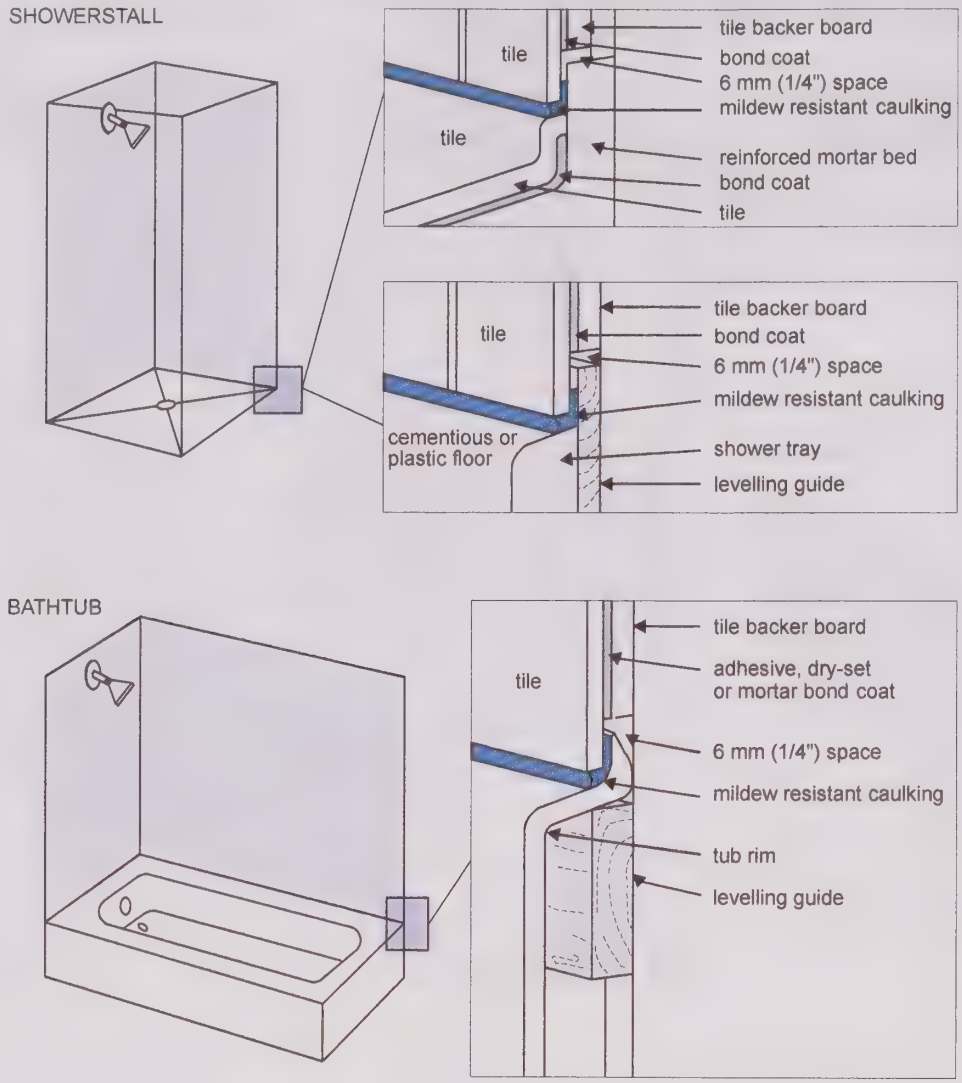


Figure 14.14
Sealing Between Tile and tub or Shower

(9.29.10.5.)

FINISH FLOORING

BUILDING CODE REFERENCES

DIVISION B

9.30.1.1.	Required Finish Flooring
9.30.1.2.	Water Resistance
9.30.1.3.	Sleepers
9.30.1.4.	Finish Quality
9.30.2.1.	Required Underlay
9.30.2.2.	Materials and Thickness
9.30.2.3.	Fastening
9.30.2.4.	Joints Offset
9.30.2.5.	Surface Defects
9.30.3.1.	Thickness
9.30.3.2.	Strip Direction and End Joints
9.30.3.3.	Nailing
9.30.3.4.	Staples
9.30.4.1.	Adhesive
9.30.5.1.	Materials
9.30.6.1.	Substrate

General Requirements for Flooring

Finish flooring must be smooth, clean, and free of surface defects that can result in cracks, crevices or unevenness. Flooring must be water resistant in bathrooms, kitchens, laundry rooms, and general storage areas. Floor finish types that are acceptable in these areas include resilient flooring, felted-synthetic-fibre flooring, concrete, terrazzo, ceramic tile, wood flooring, or mastic. Carpeting is not acceptable in this application.

Sleepers supporting flooring on concrete that is is contact with the ground must be at least 19 mm by 38 mm (1 x 2) and treated with a wood preservative.

Panel-type underlay is required for the flooring systems with subfloor and finish floors combinations identified in Figure 14.15.

Panel-type underlay must be at least 6 mm (1/4") thick and must conform to a number of standards listed in 9.30.2.2. of the Code.

Panel-type underlay must be fastened to the subfloor with staples, annular grooved flooring nails, or spiral nails spaced not more than 150 mm (5-7/8") o.c. on the edges and 200 mm (7-7/8") o.c. both directions on the panel interior face.

Nails for 6 mm (1/4") thick underlay must be at least 19 mm (3/4") long; 7.9 mm (5/16") thick underlay must be fastened with nails that are at least 22 mm (7/8") long.

Staples for underlay must have a shank diameter of at least 1.2 mm (1/16") with a crown width of at least 4.7 mm (3/16") and must be at least 22 mm (7/8") long for 6 mm (1/4") thick underlay and 28 mm (1-1/8") long for 7.9 mm (5/16") and 9.5 mm (3/8") thick underlays.

Joints of the underlay must be staggered at least 200 mm (7-7/8") from joints of plywood, waferboard, or OSB subflooring. Any surface defects in the underlay such as holes must be filled and patched with resilient flooring or ceramic tiles with adhesive are installed.

Ceramic Tile Flooring

Ceramic tile must be either set in a mortar bed, or applied to a sound smooth base with a suitable adhesive (see ceramic tile best practices on the following pages). When ceramic tile is applied with an adhesive, the panel-type sub-floor must have its edges supported as per Article 9.23.14.3.

Flooring Systems Requiring Panel-Type Underlay

Subfloor	Finish Floor
panel-type with unsupported edges, or lumber	resilient, parquet, ceramic, carpeting or felted synthetic fibre or carpet (over lumber)
waferboard or OSB	resilient
all types	ceramic tile applied with adhesive

Figure 14.15
Panel Type Underlay (9.30.2.1.)

Better Building Note

Ceramic Tile Best Practices
Excerpts from the Terrazzo, Tile & Marble Association of Canada Tile Installation Manual

The following are best practices regarding the installation of interior ceramic tile floors in dry areas. These details represent a guide for usual circumstances. The following information references details 313F-2012-2014 and 311F-2012-2014. Please consult the Tile Installation Manual and manufacturer instructions for more information.

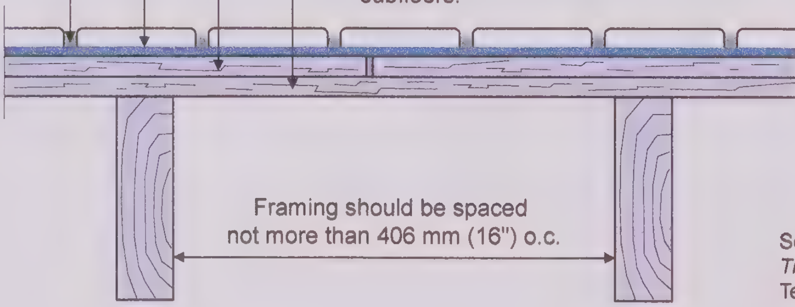
Detail A - Thin-Set on Plywood

Grout
The grout should be Portland cement, latex-Portland cement (minimum ANSI A 118.6 or ISO CG1), or epoxy grouts (minimum ANSI A 118.3 or ISO RG). Once the bond coat is cured, force grout into the full depth of the joint, remove excess, and clean.

Bond Coat and Tiles
Bond coats should be Latex-Portland cement mortars (minimum ANSI A 118.11 or ISO C2S1), modified epoxy emulsion mortars, or 100% solids epoxy mortars (minimum ANSI A 118.3 or ISO R1). The tiles should have at least 80% contact with the bond coat, and contact should be evenly distributed.

Plywood Underlayment
Panel underlayment should be only 16 mm (5/8") or thicker Douglas Fir exterior-grade plywood Select Tight-faced meeting CSA-0121 and should be attached with 30mm (1-1/8") screws spaced 150 mm (6") o.c. around the perimeter and 200 mm (7-7/8") o.c. throuhgout the panel. The screws should penetrate through the thickness of the assembly, but not the joists, cross-bridging, or solid blocking. Waferboard, particle board, or similar products should not be used for underlayment.

Panel Sub-floor
Sub-floor should be either Douglas Fir plywood, Canadian Softwood plywood, Poplar plywood, Construction sheathing, or OSB. Both layers of panel should be applied with the top grain at right angles to the joists with the top layer staggered for a 50% overlap with the sub-floor. A 6 mm (1/4") gap should be left between the top layer of plywood sheets. Waferboard, particle board, or similar products should not be used for subfloors.



Source: *Specification Guide 09 30 00 Tile Installation Manual 2012-2014.* Terrazzo, Tile & Marble Association of Canada.

Better Building Note

Ceramic Tile Best Practices Continued

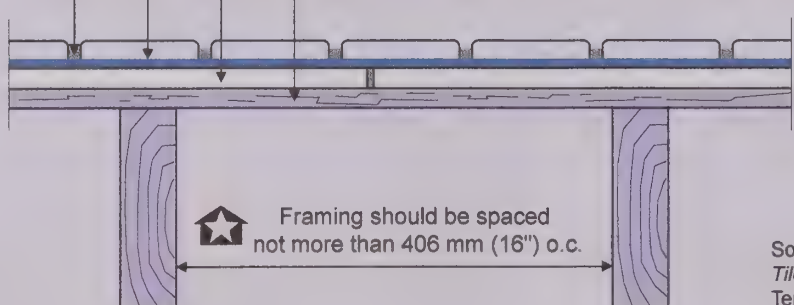
Detail B - Thin-Set on Backer Unit/ Board

Grout
The grout should be Portland cement, latex-Portland cement (minimum ANSI A 118.6 or ISO CG1), or epoxy grouts (minimum ANSI A 118.3 or ISO RG). Once the bond coat is cured, force grout into the full depth of the joint, remove excess, and clean.

Bond Coat and Tiles
Bond coats should be Latex-Portland cement mortars (minimum ANSI A 118.11 or ISO C2S1), modified epoxy emulsion mortars, or 100% solids epoxy mortars (minimum ANSI A 118.3 or ISO R1). The application of the bond coat should fill in gaps in underlayment. The tiles should have at least 80% contact with the bond coat, and contact should be evenly distributed. Tiles should be applied before the bond coat skins over.

Backer Unit/ Board
Underlayment should be 13 mm (1/2") cementitious backer unit (CBU), coated glass mat backer board, or nominal 11 mm (7/16") fibre-cement backer board meeting ASTM C1288 bedded in latex-Portland cement mortar (minimum ANSI A 118.4 or ISO C2) and gapped 3 mm (1/8"). Waferboard, particle board, or similar products should not be used for underlayment. Underlayment should be fastened to sub-floor with 30 mm (1-1/8") galvanized screws at 200 mm (7-7/8") o.c. throughout the body of the panel. The screws should not be countersunk for coated glass mat backer board. Joints should be treated using the manufacturer's instructions.

Panel Sub-floor
Sub-floor should be either Douglas Fir plywood, Canadian Softwood plywood, Poplar plywood, Construction sheathing, or OSB. Waferboard, particle board, or similar products should not be used for subfloors.



Source: *Specification Guide 09 30 00 Tile Installation Manual 2012-2014.* Terrazzo, Tile & Marble Association of Canada.

Better Building Note

Ceramic Tile Best Practices Continued

Detail C - Mortar Bed with Cleavage Membrane

Grout
The grout should be Portland cement, latex-Portland cement (minimum ANSI A 118.6 or ISO CG1), or epoxy grouts (minimum ANSI A 118.3 or ISO RG). Once the bond coat is cured, force grout into the full depth of the joint, remove excess, and clean.

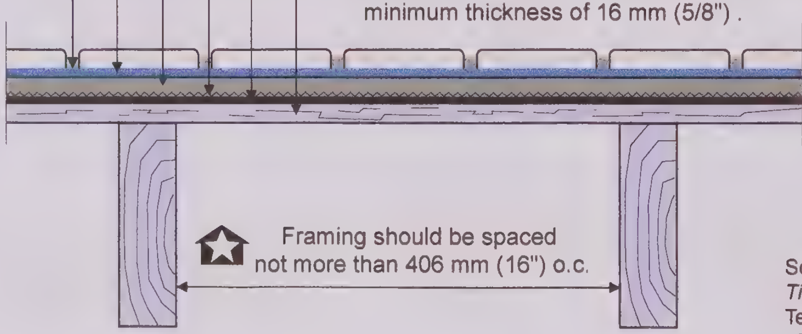
Bond Coat and Tiles
Bond coats should be Latex-Portland cement mortars (minimum ANSI A 118.11 or ISO C2S1), modified epoxy emulsion mortars, or 100% solids epoxy mortars (minimum ANSI A 118.3 or ISO R1). The tiles should have at least 80% contact with the bond coat, and contact should be evenly distributed. Tiles should be applied before the bond coat skins over. For a fresh mortar bed, beat tile into position. For a dry-set mortar, slide tile into position.

Mortar Bed
Apply the mortar bed to 32 mm (1-1/4") thickness. Allow mortar bed to cure. The finished tolerance of the mortar bed should not exceed 6 mm (1/4") in 3 m (10') or 2 mm (1/16") in 300 mm (11-3/4"). If large tiles are used (one edge is 380 mm (15") or longer), the maximum variation should be not more than 3 mm (1/8") in 3 m (10'). Mortar mix detailed in Installation Manual.

Galvanized Metal Lath
The galvanized diamond metal lath (1.4 kg/m², ASTM C847-95) should be nailed to the plywood with sheets butted, not overlapped.

Polyethlyene Film
The 6 mil polyethylene meeting CAN/CGSB-51.34M should be lapped a minimum of 100 mm (4"), it may be substituted with asphalt saturated roofing felt conforming to CSA A123.3-98.

Panel Sub-floor
Sub-floor should be either Douglas Fir plywood, Canadian Softwood plywood, Poplar plywood, Construction sheathing, or OSB. Plywood to be exterior grade and meet CSA 0121; OSB to meet CSA 0437.0 or CSA 0325.0. Waferboard, particle board, or similar products should not be used for subfloors or underlayment. The sub-floor should have a minimum thickness of 16 mm (5/8") .



Source: *Specification Guide 09 30 00 Tile Installation Manual 2012-2014.* Terrazzo, Tile & Marble Association of Canada.

Better Building Note

Ceramic Tile Best Practices Continued

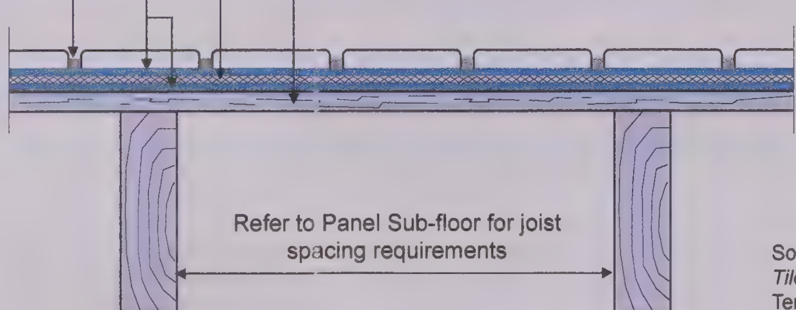
Detail D - Thin-Set on Uncoupling System

Grout
The grout should be Portland cement, latex-Portland cement (minimum ANSI A 118.6 or ISO CG1), or epoxy grouts (minimum ANSI A 118.3 or ISO RG). Once the bond coat is cured, force grout into the full depth of the joint, remove excess, and clean.

Bond Coat and Tiles
Bond coats should be Latex-Portland cement mortars (minimum ANSI A 118.11 or ISO C2S1), modified epoxy emulsion mortars, or 100% solids epoxy mortars (minimum ANSI A 118.3 or ISO R1). The tiles should have at least 80% contact with the bond coat, and contact should be evenly distributed.

Uncoupling System
The uncoupling should be installed as per the manufactuer's recommendations.

Panel Sub-floor
Sub-floor should be a minimum 15 mm (9/16") of either Douglas Fir plywood, Canadian Softwood plywood, Poplar plywood, Construction sheathing, or OSB for joists spaced 406 mm (16") o.c. For floors supported with trusses or I-joists spaced at 480 mm (18-7/8") o.c. the sub-floor should be at least 20 mm (3/4") thick meeting CSA-0121. Where trusses or I-joists are spaced 600 mm (23-5/8") o.c., subfloor should be 20 mm (3/4") with an overlay of 10 mm (3/8") plywood meeting CSA-0121 or OSB meeting CSA 0437.0 or CSA 0325.0, with a 3 mm (1/8") gap between sheets. Screws for the underlayment should go through the total thickness of the assembly, but should not penerate the joists, cross-bridging, or solid blocking. Waferboard, particle board, or similar products should not be used for subfloors or underlayment.



Source: *Specification Guide 09 30 00 Tile Installation Manual 2012-2014.* Terrazzo, Tile & Marble Association of Canada.

Better Building Note

Ceramic Tile Best Practices Continued

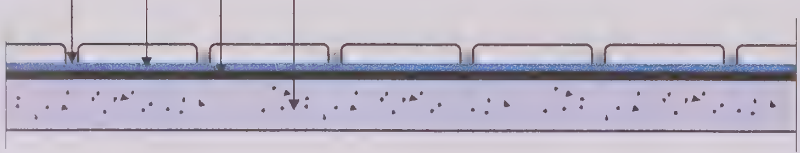
Detail E - Tile Bonded to Concrete Slab - Thin-Set Method

Grout
The grout should be Portland cement, latex-Portland cement (minmum ANSI A 118.6 or ISO CG1), or epoxy grouts (minimum ANSI A 118.3 or ISO RG). Once the bond coat is cured, force grout into the full depth of the joint, remove excess, and clean.

Bond Coat and Tiles
Bond coats should be dry-set mortar (minimum ANSI A 118.1 or ISO C1), Latex-Portland cement mortars (minimum ANSI A 118.4 or ISO C2S1), modified epoxy emulsion mortars, 100% solids epoxy mortars, epoxy adhesive (minimum ANSI A 118.3 or ISO R1), or organic adhesive (minimum ANSI A 118.3 or ISO R1).
The tiles should have at least 80% contact with the bond coat for dry surfaces, and contact should be evenly distributed. Tiles should be applied before the bond coat skins over. Slide tile into position.

Waterproof / Uncoupling Membrane if Required
Waterproof membrane, if required, should comply with ANSI A 118.10 and should be installed as per the manufacturer's recommendations. Uncoupling membrane should be installed as per the manufacturer's recommendations. For the tile bond coat, it may require unmodified dry-set mortar.

Concrete Slab
The slab should not have variations greater than 6 mm (1/4") in 3 m (10') or 2 mm (1/16") in 300 mm (11-3/4"). If large tiles are used (one edge is 380 mm (15") or longer), the maximum variation should be not more than 3 mm (1/8") in 3 m (10'). Allow for a minimum curing time of 28 days. Slab surface should be clean.



Source: *Specification Guide 09 30 00 Tile Installation Manual 2012-2014*. Terrazzo, Tile & Marble Association of Canada.

Wood Strip Flooring

Wood strip flooring must have a thickness that conforms to Figure 14.16. Unless an underlay is provided, strips must not be laid parallel to lumber subflooring. If no subfloor is provided, 19 mm (3/4") strips must be laid perpendicular to joist direction so that end joints are staggered on supports or are staggered and end matched. End matching requires that no two adjoining strips break their joints within the same joist space and each strip must be supported by at least two joists.

Nailing of wood strip flooring requires either toe nailing or face nailing with at least one nail per strip in accordance with Figure 14.17 except that face nailed strips of at least 25 mm (1") in width must have at least 2 nails per strip. All face nailed strips must be countersunk. Staples may be used for wood strip flooring that is not greater than 7.9 mm (5/16") thick provided that the staples are at least 29 mm (1-1/8") with a shank diameter of at least 1.19 mm (1/16") and 4.7 mm (3/16") wide crowns. Refer to Figure 14.18 for proper practices of nailing and installing wood strip flooring.

Wood strip flooring is manufactured in an assortment of sizes and is available in different grades. The lengths are generally random and usually tongue and groove. The sides of the strips are slightly wider apart at the top to guarantee a flush fit and are normally hollowed back. The tongues must fit snugly into the grooves to reduce the likelihood of squeaky floors.

Adhesive may be used to adhere wood strip flooring if approved by the chief building official. Be sure to follow the manufacturer's recommended method of installation.

Special care must be exercised when designing a wood floor immediately above concrete, for example in basements. An incorrectly installed finished floor may fail prematurely and may be accompanied by molds.

Wood strip floors expand in humid conditions. If installed in dry conditions and no expansion gap is provided, floors can lift or buckle when moist conditions occur.

Wood Strip Flooring

Type of Flooring	Maximum Joist Spacing, mm (ins)	Minimum Thickness of Flooring, mm (in)	
		With Subfloor	No Subfloor
Matched hardwood (interior use only)	406 mm (16") 610 mm (24")	7.9 mm (5/16") 7.9 mm (5/16")	19.0 mm (3/4") 33.3 mm (1-5/16")
Matched softwood (interior or exterior use)	406 mm (16") 610 mm (24")	19.0 mm (3/4") 19.0 mm (3/4")	19.0 mm (3/4") 31.7 mm (1-1/4")
Square edge softwood (exterior use only)	406 mm (16") 610 mm (24")	- -	25.4 mm (1") 38.1 mm (1-1/2")

Figure 14.16
Wood Strip Flooring (9.30.3.1.)

Nailing of Wood Strip Flooring

Finish Floor Thickness, mm (in)	Minimum Length of Flooring Nails, mm (in)	Maximum Spacing of Flooring Nails, mm (in)
7.9 mm (5/16")	38 mm (1-1/2")	200 mm (7-7/8")
11.1 mm (7/16")	51 mm (2")	300 mm (11-3/4")
19.0 mm (3/4")	57 mm (2-1/4")	400 mm (15-3/4")
25.4 mm (1")	63 mm (2-1/2")	400 mm (15-3/4")
31.7 mm (1-1/4")	70 mm (2-3/4")	600 mm (23-5/8")
38.1 mm (1-1/2")	83 mm (3-1/4")	600 mm (23-5/8")

Figure 14.17
Nailing of Wood Strip Flooring (9.30.3.3.)

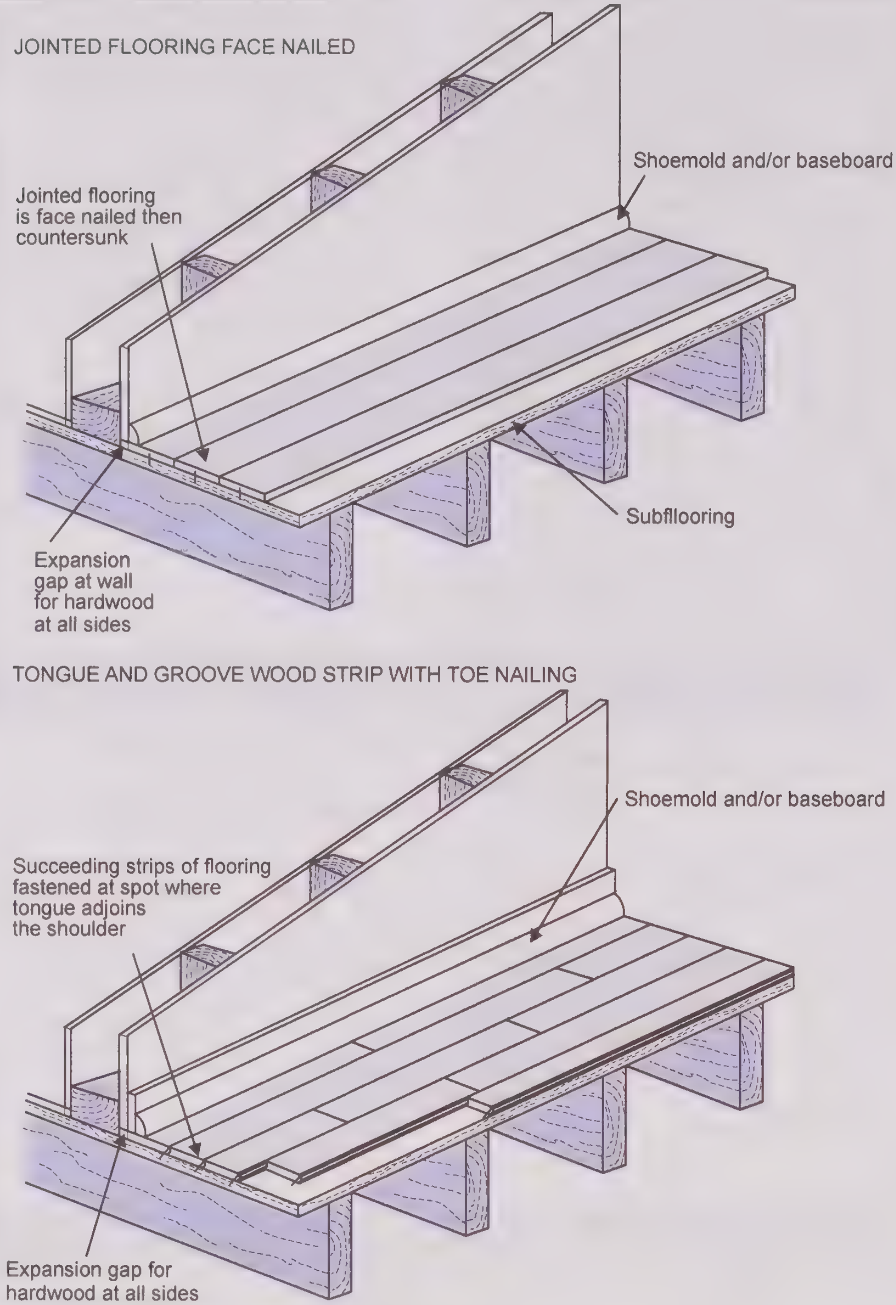
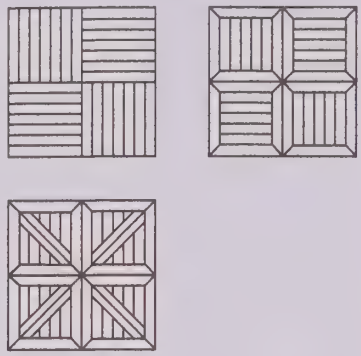


Figure 14.18
Installation and Nailing of Wood Strip Flooring (9.30.3.2.)



Common Types of Parquet Flooring

Parquet Flooring

Parquet flooring consists of prefabricated strips of wood laminated together to make a variety of patterns - the most common shown above. Parquet flooring is most generally 7.9 mm (5/16") thick. Thicker varieties are often used in complicated patterns where strength and rigidity are important.

Adhesives that are suitable for the bonding of wood to the specific subfloor material are essential for the proper installation of parquet flooring.

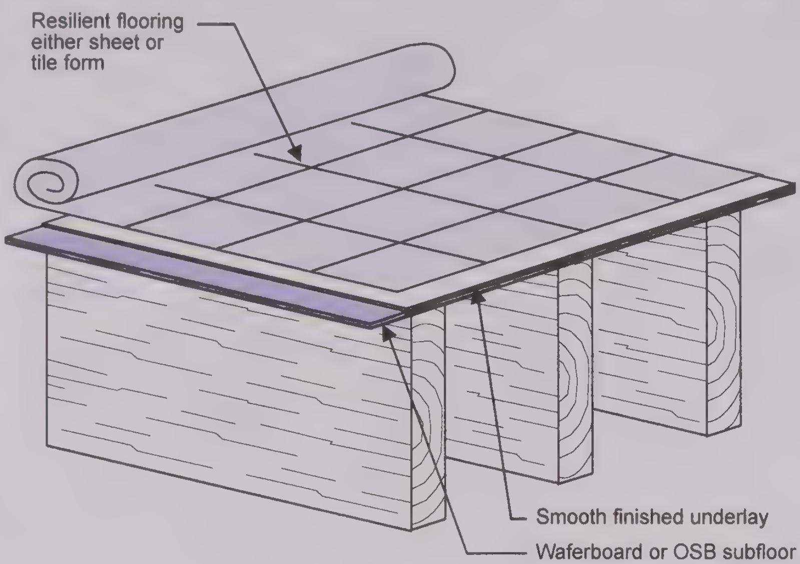


Figure 14.19
Resilient Flooring (9.30.5.)

Resilient Flooring

Resilient flooring used on concrete floors supported on ground must be any of the following: asphalt, rubber, vinyl-asbestos, unbacked vinyl, or vinyl with inorganic backing. The adhesive for the types of permitted flooring must be waterproof and alkali-resistant.

Resilient flooring may be laid over concrete and wood substrates. Special care should be taken in removing any bumps and lumps that would show through the finish and potentially damage it. The name of the flooring reflects the nature of the finish. See Figure 14.19.

Engineered Hardwood Floors

Engineered wood floors are comprised of planks made from 3-5 laminated wood sheets. The layers are stacked in opposite directions (cross-ply construction), increasing the strength and moisture resistance of the planks, although many manufacturers still do not recommend installing these floor systems in rooms where humidity can fluctuate. Installation can range from nailing, stapling, gluing, or floated - builders should refer to the manufacturer's installation instructions.

Laminate Flooring

Laminate flooring is a popular finish flooring option. It consists of planks or squares comprised of various, sandwiched layers of synthetic materials, and replicates the appearance of wood, stone, or ceramic flooring. This type of flooring has a durable wearlayer to provide resistance to wear and stains.
The flooring system fits together by tongue and groove. Below are a number of best practices when installing this type of flooring.

- The subfloor should be clean and smooth before work commences.
- If the laminate is being installed on a concrete sub-floor, an underlayer can be provided to prevent the laminate from being damaged by moisture.
- The laminate should be acclimatized to the room conditions for 48 hours before installation.
- Installation requirements vary by manufacturer. Review the installation instructions.
- Variations in the surface should be minimal; refer to the manufacturer's installation instructions.
- A 3 mm (1/8") expansion gap should be maintained around the perimeter.
- Edge seams and the expansion gap should be completely concealed under base molding that should rest flush on the flooring. The base molding should be secured to the wall as opposed to the floor.
- The finished floor should feel solid under pressure.
- Laminate flooring should not be installed in a room where it is at risk of being exposed to water or excess humidity.

15 EXTERIOR FINISHES

This Chapter of the Guide presents the requirements for exterior finishes in housing. Emphasis is placed on minimum requirements as well as good workmanship and proper installation practices.

Exterior finishes are presented in four sections in this Chapter: Masonry Veneer, Glass Block, Cladding, and Stucco Finishes. In each of these sections, requirements are presented in the order of installation on site.

In Chapter 7, Wall Systems, the four main functions of a wall were discussed. This Chapter focuses primarily on one of those functions, namely the control of exterior moisture, typically a function that is provided by the exterior finish.

Exterior finishes can perform as intended provided the rules established in the Code are followed, appropriate materials are selected, and manufacturers' instructions are carefully observed. Poorly installed exterior finishes can result in moisture entry, decay and deterioration.

KEY POINTS

Exterior finishes must be designed and constructed to fulfill the following functions:

- restrict the penetration of snow and rain;
- allow for the drainage of any moisture from behind the exterior finish; and
- be constructed in a manner which ensures the long term durability of the exterior finish.

MASONRY VENEER

BUILDING CODE REFERENCES

DIVISION B
9.15.4.7. Reduction in Thickness
9.20.1.1. General
9.20.2.7. Compressive Strength
9.20.3.1. Mortar Materials
9.20.4.1. Thickness
9.20.4.2. Solid Masonry Units
9.20.4.3. Hollow Masonry Units
9.20.5.2. Lintels or Arches
9.20.6.4. Masonry Veneer
9.20.6.6. Stone or Concrete Facings
9.20.8.5. Distance to Edge of Supporting Members
9.20.9.4. Tying
9.20.9.5. Ties for Masonry Veneer
9.20.12.3. Corbelling for Masonry Veneer
9.20.13.1. Materials for Flashing
9.20.13.2. Fastening of Flashing
9.20.13.3. Location of Flashing
9.20.13.4. Extension of Flashing
9.20.13.6. Flashing for Weep Holes in Masonry Veneer
9.20.13.7. Flashing Joints
9.20.13.11. Caulking at Door and Window Frames
9.20.13.12. Drips Beneath Window Sills
9.27.3.4. Insulating Sheathing in Lieu of Sheathing Membranes
9.27.3.5. Sheathing Membranes in Lieu of Sheathing

The scope of Section 9.20. is limited to non-loadbearing, masonry veneer and insulating concrete form walls not in contact with the ground. Masonry veneer walls must not extend more than 11 m (36' 1") above the foundations. Part 4 must be used for the design of buildings where unreinforced masonry walls support more than one floor or a roof of concrete construction. Flat insulating concrete form walls must have a maximum floor-to-floor height of 3 m (9'10") and erected in a single dwelling unit not more than 2 storeys high in a location where the seismic spectral response acceleration $S_a(0.2)$ is not greater than 0.4 as specified in Article 9.20.1.1. of the Code.

See Climatic and Seismic Data in Supplementary Standard SB-1.

Maximum Allowable Spans for Steel Lintels Supporting Masonry Veneer, m (ft-in)

Minimum Angle Size, mm (in)			70 mm (2-3/4")	90 mm (3-1/2")	100 mm (4")
Vert. Leg	Horiz. Leg	Thickness	Brick	Brick	Stone
89 (3-1/2")	76 (3")	6.4 (1/4")	2.55 (8' 5")	-	-
89 (3-1/2")	89 (3-1/2")	6.4 (1/4")	2.59 (8' 6")	2.47 (8' 1")	2.30 (7' 9")
102 (4")	89 (3-1/2')	6.4 (1/4")	2.79 (9' 2")	2.66 (8' 9")	2.48 (8' 2")
127 (5")	89 (3-1/2")	7.9 (5/16")	3.47 (11' 5")	3.31 (10' 10")	3.08 (10' 1")
127 (5")	89 (3-1/2")	11 (3/8")	3.64 (11' 11")	3.48 (11' 5")	3.24 (10' 8")
127 (5")	89 (3-1/2")	13 (1/2")	3.82 (12' 7")	3.59 (11' 9")	3.33 (10' 11")
152 (6")	89 (3-1/2")	11 (3/8")	4.06 (13' 4")	3.82 (12' 7")	3.54 (11' 8")
152 (6")	89 (3-1/2")	13 (1/2")	4.32 (14' 2")	4.07 (13' 5")	3.77 (12' 5")
152 (6")	102 (4")	13 (1/2")	4.37 (14' 4")	4.12 (13' 6")	3.82 (12' 7")
178 (7")	102 (4")	11 (3/8")	4.57 (15' 0")	4.30 (14' 1")	3.99 (13' 1")
178 (7")	102 (4")	13 (1/2")	4.87 (16' 0")	4.59 (15' 1")	4.25 (14' 0")

Figure 15.1
Maximum Allowable Spans for Steel Lintels Supporting Masonry Veneer (9.20.5.2.)

General

Masonry veneer requires specific temperature conditions during installation. Masonry and mortar must be kept at a temperature of at least 5°C (41°F) during application and for at least 48 hours afterwards. Material in any mortar mix and all masonry building components must not be used if frozen. The top of any unfinished masonry work must be protected from the weather with a waterproof material while the laying of that masonry is not in progress. Failure to observe these requirements will lead to masonry work with substandard strength and durability.

Support of Masonry Veneer

Masonry veneer can only be supported by masonry, concrete, steel, or preserved wood foundations. Masonry veneer must not vary in thickness except for corbelling which is discussed in Subsection 9.20.12. of the Code.

Steel lintels supporting masonry veneer above openings must have even and level bearing and must be supported by at least 150 mm (5-7/8") bearing length at each end.

Support of masonry veneer over openings in walls using steel angle lintels must conform to the table in Figure 15.1 or be determined by a competent designer. A number of common types of arches may be constructed to support masonry veneer over openings.

Masonry Units

Subsection 9.20.2. of the Code lists the standards for unit masonry. Bricks that have been used in previous construction must be cleaned of old mortar and any other deposits of dust, dirt, or soot and must conform to the referenced standard.

The compressive strength of concrete blocks must conform to Figure 15.2.

Stone must be durable and structurally sound. The construction requirements for stone veneer walls are the same as those for brick veneer and include all the brick veneer limitations.

Mortar and Grout

Cementitious materials and aggregates used in mortar and grout mixes must comply with CAN/CSA A179, "Mortar and Grout for Unit Masonry". All water and aggregates must be clean and contain minimal contaminating materials. All lime that is used in mortar must be slaked (completely saturated with water). Lime putty must be slaked for at least 24 hours, and previously hydrated lime must be slaked for at least 12 hours.

Required mortar and grout mix proportions are shown in Figure 15.3 and 15.4. Mortar mixes must be provided with sufficient water to bring the mixture to a consistency that is adequate for laying masonry units. Grout mixes must be provided with sufficient water to ensure a suitable flow to fill all voids completely without excessive segregation or bleeding.

Portland cement mortar must be used within 1.5 hours of mixing when the air temperature is 25°C (77°F) or higher or within 2.5 hours of mixing when the air temperature is less than 25°C (77°F). Mortar and grout containing a set-control admixture must be manufactured off-site and used as required by the manufacturer's specification. Grout used in reinforced masonry must be placed in accordance with the requirements of CAN/CSA-A371 "Masonry Construction for Buildings."

Compressive Strength of Concrete Blocks

Type of Block	Minimum Compressive Strength over Net Area, MPa (psi)	
	Exposed to Weather	Not Exposed to Weather
Solid or hollow concrete blocks	15 (2200)	10 (1500)
Solid loadbearing cellular blocks	Not permitted	5 (730)
Solid non-loadbearing cellular blocks	Not permitted	2 (290)

Figure 15.2
Compressive Strength of Concrete Blocks (9.20.2.7.)

Mortar Use

Location	Building Element	Mortar Type
Exterior, above ground	Loadbearing walls and columns Non-loadbearing walls and columns Parapets, chimneys and masonry veneer	S N or S N or S
Exterior, at or below ground	Foundation walls and chimneys	S
Interior	Loadbearing walls and columns Non-loadbearing walls and columns	N N

Mortar Mix Proportions (by Volume)

Mortar Type	Portland Cement	Lime	Masonry Cement Type N	Masonry Cement Type S	Fine Aggregate (damp, loose-state sand)
S	1	1/2	-	-	3-1/2 to 4-1/2
	-	-	-	1	2-1/4 to 3
	1/2	-	1	-	3-1/2 to 4-1/2
N	1	1	-	-	4-1/2 to 6
	-	-	1	-	2-1/4 to 3

Figure 15.3
Mortar Use and Mix Proportions (By Volume) (9.20.3.2.)

Grout Mix Proportions (by Volume)

Portland Cement	Lime	Fine Aggregate (sand)	Coarse Aggregate
1	0 to 1/10	2-1/4 to 3 times the sum of the cement and lime volumes	1 to 2 times the sum of the cement and lime volumes

Figure 15.4
Grout Mix Proportions (By Volume) (9.20.3.2.)

Better Building Note

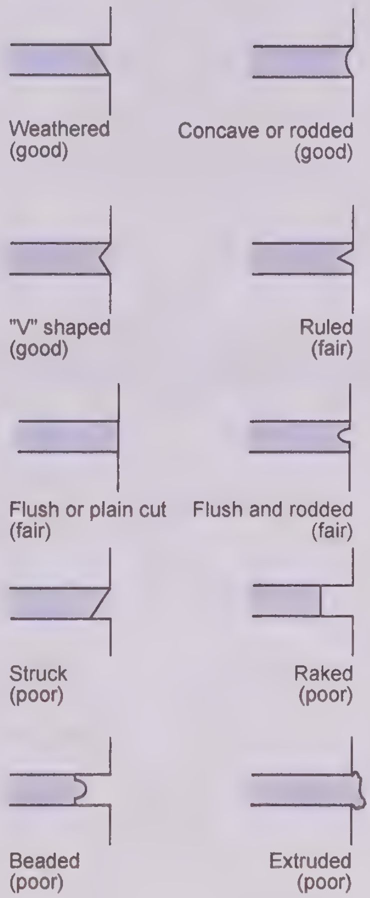
To ensure good bonding, a spread of mortar should not be left for more than 1 minute before the application of the masonry units. Never tap or push a unit once the mortar has started to harden as the bond may be damaged or weakened.

It is recommended that the tooling of mortar joints be done when the mortar is thumb-print hard. A number of different types of tooling are shown on the right.

Excess mortar on the face of masonry units should be removed with a putty knife, wire brush, or chisel. White or buff faced bricks should not be cleaned with a wire brush. If muriatic acid (hydrochloric) is used, it should not be stronger than 1 part acid for 9 parts water by volume and applied with a wire brush from the top down. Surfaces to be cleaned with the acid should be rinsed thoroughly with water before, during and after cleaning. Light coloured or buff brick should be cleaned with soapy water or sodium hydroxide (for tough stains) with the same concentration as the muriatic acid above.

Mortar or grout that is freshly mixed forms a calcium hydroxide solution that is corrosive to skin tissue. Direct contact should be avoided at all times, as skin irritation and even severe burns may result.

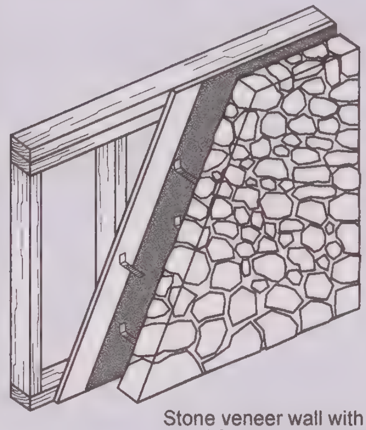
TYPES OF JOINTS



Stone Veneer Walls

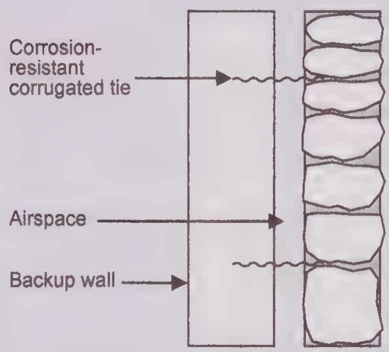
Stone veneer must be solidly supported by a wall system conforming to the requirements discussed in Chapter 7.

Different types of stone wall patterns can influence the construction of the wall.



Stone veneer wall with wood frame backup wall

Cavity wall



Mortar Joints

The average mortar joint must be 10 mm (3/8") thick. Head and butt joints can be reduced to a minimum of 5 mm (3/16") or increased to a maximum of 19 mm (3/4"). Solid masonry units must be laid with a full bed of mortar that will allow the mortar to extend through the finger holes and connect to provide additional reinforcement of the wall except for head joints left open for weep holes and ventilation.

Vertical joints in adjacent masonry courses must be offset unless the veneer is reinforced with an equivalent of two corrosion resistant steel bars at least 3.76 mm (5/32") in diameter placed horizontally at intervals not greater than 460 mm (18-1/8"). The ends of this reinforcing must be lapped at least 150 mm (5-7/8").

Thickness and Height

Masonry veneer must be solid and at least 70 mm (2-3/4") thick where it is not supported individually by structural backing. Masonry of less than 90 mm (3-1/2") thickness must not have raked joints.

Brick veneer walls that are built up against another type of backing and the installation of stone or precast panels must conform to CSA-S304, "Masonry Design for Buildings."

Better Building Note

A power mixer should be used for mixing mortar for at least 3 minutes once all materials for that batch have been added. Retempering mortar by adding an adequate volume of water is highly recommended to guarantee good workability of the mortar.

The primary concern with the mortar during extreme weather conditions is to ensure that it will set properly.

Freezing weather can cause ice development within the mortar leading to weak, poorly cured mortar.

Cold weather requires that water and aggregates are mixed first if the water is heated (or boiling). Check that the temperature is not greater than 50°C (122°F) before the cement is added. If the aggregate is heated instead of the water, it should not be heated above the temperature of 70°C (158°F) or else the structural integrity of the sand may be jeopardized. Antifreeze, salts, and any other such additives should not be used in mixing mortar for use in masonry.

Mixing mortar in hot weather requires that the aggregate is kept damp by spraying lightly with water periodically. When possible, re-schedule masonry work until cooler conditions are foreseen. Early mornings and evenings are suggested.

Flash set is the result of mixing mortar when it is too hot. The heat accelerates the curing process and makes the mortar difficult to work with. This reduces the strength and durability of a stone or masonry veneer wall.

Mortar that is too cold will not set and harden, leading to severe distortion and possibly collapse as stresses within the veneer cause the courses to slip over one another.

Protection Requirements

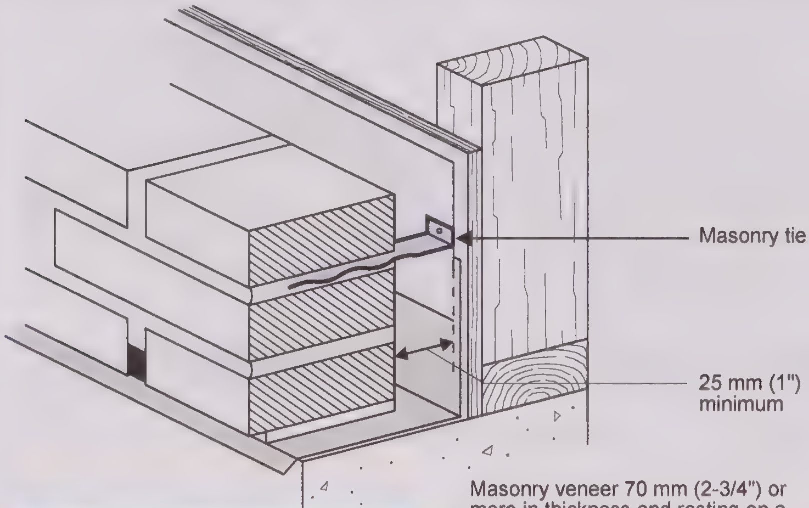
Mean Daily Air Temp.	Protection Requirements	Construction Requirements
0 to 4°C	Masonry shall be protected from rain or snow for 24 hours	Sand or mixing water shall be heated to a minimum of 20°C and a maximum of 70°C.
0 to -4°C	Masonry shall be completely covered with insulating blankets for 24 hours.	Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C.
-4 to -7°C	Masonry shall be completely covered with insulating blankets for 24 hours.	Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C. Heat shall be provided on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 25 km/h.
less than -7°C	The masonry temperature shall be maintained above 0°C for 24 hours by enclosure and supplementary heat.	Sand and mixing water shall be heated to a minimum of 20°C and a maximum of 70°C. Enclosures and auxiliary heat shall be provided to maintain air temperarure above 0°C.

Source: CSA-A371 Masonry Construction for Buildings

Protection Requirements

Looking Back

See Chapter 7 for information on masonry chases and recesses, and for information on ICFs.



Masonry veneer 70 mm (2-3/4") or more in thickness and resting on a bearing support shall be tied to masonry back-up or to wood framing members with not less than 0.76 mm (1/32") thick, 22 mm (7/8") wide corrosion-resistant straps spaced in accordance with table below, and shaped to provide a key with the mortar.

Maximum Veneer Tie Spacing

Vertical Spacing mm (in)	**Horizontal Spacing** mm (in)
400 (15-3/4")	800 (31-1/2")
500 (19-3/4")	600 (23-5/8")
600 (23-5/8")	400 (15-3/4")

Ties may be installed against any of the sheathings listed in the Code Table 9.23.16.2.A provided the ties are in contact with the exterior surface of the sheathing and the sheathing beneath the ties is not compressed.

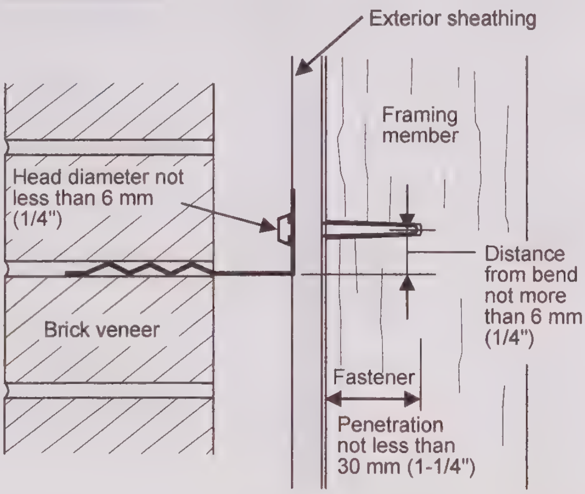


Figure 15.5
Veneer Tie Spacing

(9.20.9.5.)

Tying of Masonry Veneer

Corrosion resistant masonry veneer ties must be provided for masonry veneer 70 mm (2-3/4") or more in thickness and resting on a bearing support described earlier in this section.

Masonry veneer ties are intended to provide lateral stability and must not be less than 0.76 mm (1/32") thick, 22 mm (7/8") wide and shaped to provide a key with the mortar. The vertical and horizontal spacing of ties must conform to Figure 15.5. Care should be taken when installing ties against compressible sheathing not to crush the sheathing.

Figure 15.6 outlines tie specifications for masonry foundation walls.

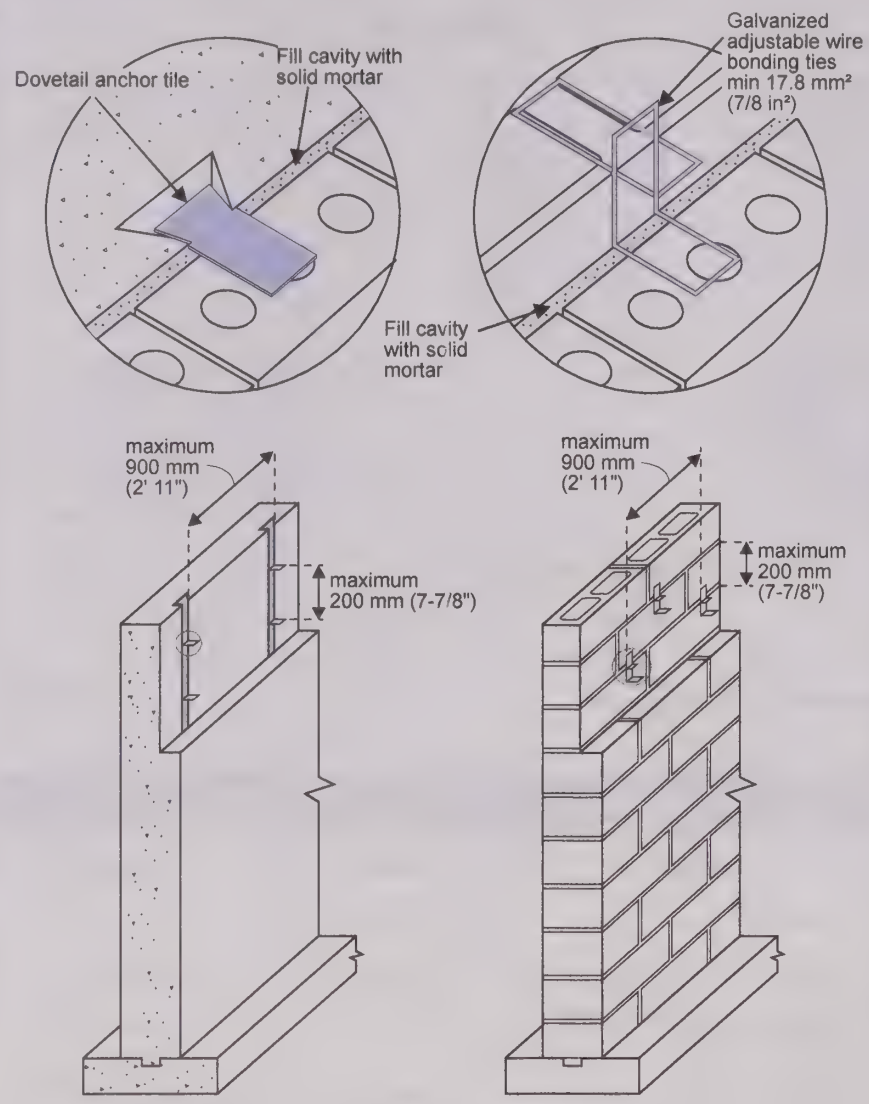


Figure 15.6
Tie Specifications for Masonry Foundation Walls (9.15.4.7.)

Projections for Veneer

Masonry veneer may project not more than 30 mm (1-3/16") from the supporting base provided that the masonry units are at least 90 mm (3-1/2") thick. Smaller masonry may only project 12 mm (1/2"). Rough faced veneer must consider the average projection of the unit's protrusions for the allowable projection. Refer to Figure 15.7 for projection requirements.

Efflorescence

Efflorescence is a term used to describe the white, crystalline deposit that occurs on the face of masonry when soluble salts are driven by moisture through the masonry.

It can be prevented by removing one of three driving elements:
- the source of the salts;
- the source of the moisture; or
- the driving force that promotes the migration of the salts and their deposit on the exterior face when the moisture evaporates.

The source of the salts is the mortar mix and possibly the masonry components whereas the driving force is due to climate – both of these causes are difficult to eliminate.

The easiest way to prevent efflorescence is to limit the entry of moisture into the wall system in the first place. Proper dampproofing of below grade masonry will also assist in eliminating this problem. Always follow the Code's prescribed caulking and flashing installation practices.

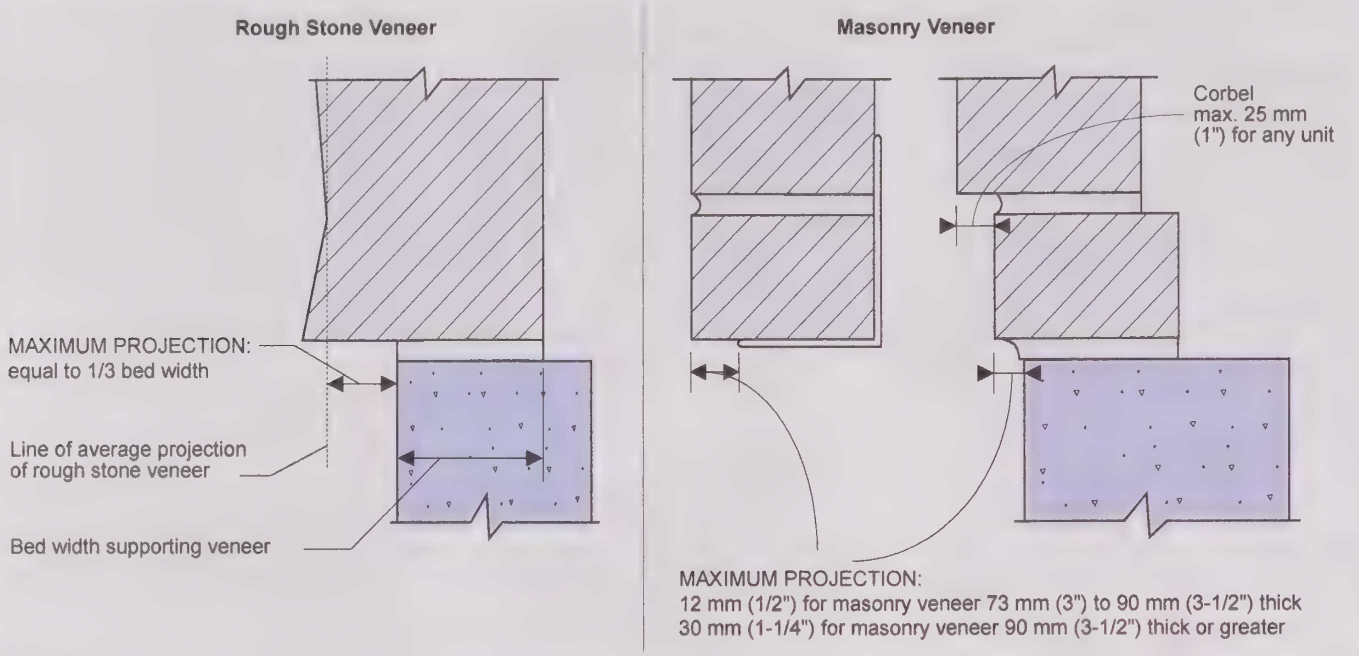


Figure 15.7
Projection and Corbelling Requirements for Masonry and Rough Stone Veneer (9.20.12.3.) (9.20.8.5.)

Control of Rain Penetration

A 25 mm (1") air space must be provided between masonry veneer and wood frame walls. The air space helps direct water that may have penetrated the masonry veneer to the flashing and out through the weep holes at the bottom of the wall.

Flashing materials are divided into two categories, exposed and concealed, and must conform to the requirements set out in Figure 15.8. Exposed flashing must be durable under weather exposure. Concealed flashing is integrated within the assembly of the wall and is not exposed directly to the outdoors.

Aluminum must not come in direct contact with masonry, concrete, or mortar joints. Where this situation may occur, an effective coating or impervious membrane must be used to protect the aluminum. All flashing joints must be watertight.

Minimum Material Thickness for Exposed or Concealed Flashing, mm (inches)

Material	Exposed	Concealed
Aluminum	0.48 (0.019)	-
Copper	0.46 (0.018)	0.46 (0.018)
Copper or aluminum laminated to kraft or felt paper	-	0.05 (0.002)
Hot dipped or galvanized steel	0.33 (0.013)	0.33 (0.013)
Sheet lead	1.73 (1/16)	1.73 (1/16)
Polyethylene	-	0.5 (0.02)
Type S roll roofing	-	standard
Zinc	0.46 (0.018)	0.46 (0.018)

Figure 15.8
Materials for Exposed or Concealed Flashing (9.20.13.1.) (9.20.13.2.)

All joints between windows and door frames must conform to the requirements of Subsection 9.27.4. set out under the heading "Sealants" later in this Chapter. Any intersection of masonry veneer with another exterior finish must be caulked with a suitable compound or be lapped to ensure that rain and snow cannot penetrate the wall assembly. Refer to Subsection 9.26.4. of the Code, for the requirements at the intersection of roofs and walls.

Masonry veneer must have flashing installed in the following locations: at the base of walls where the masonry is supported on the foundations; beneath jointed masonry window sills; over the top and back of parapet walls; over the heads of glass block panels, beneath all weep holes; and over top of window and door openings that are not within 1/4 of the distance of the eaves overhang to the underside of the eaves. Flashing must be installed so that water in a wall cavity will drain to the exterior of a building. Refer to Figure 15.9.

Fasteners for flashing must be corrosion resistant and must be suitable to the flashing material to prevent any galvanic reaction.

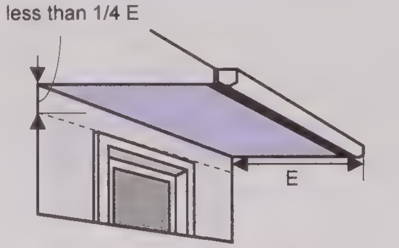
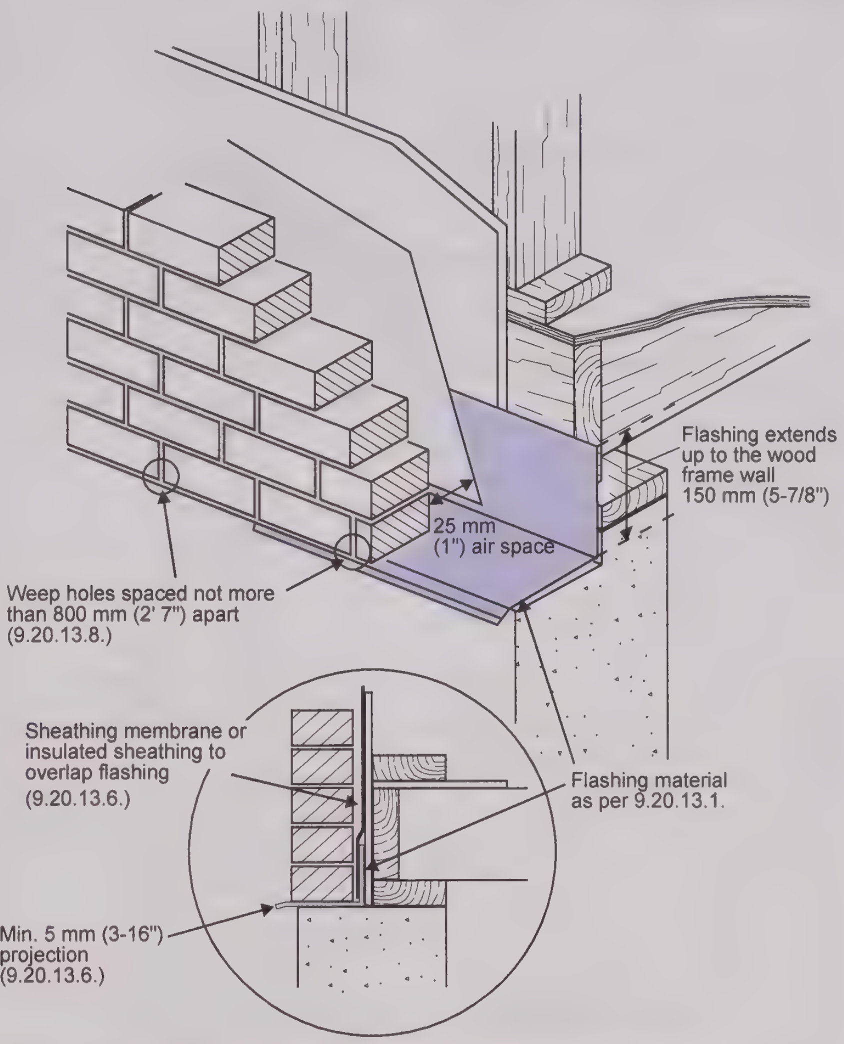


Figure 15.9
Overhang (9.20.13.3.)

Weep holes must be provided at not greater than 800 mm (2' 7") o.c. to allow any moisture in the wall cavity to escape. Weep holes are required at the bottom of cavities or air spaces in masonry veneer walls, including above lintels over door and window openings.

Flashing installation must conform to Figure 15.10. Ensure that the horizontal portion of any concealed, pliable flashings is installed upon a continuous bearing surface to prevent sags and water accumulation.



Note 1:
Where rigid foam plastic insulating sheathing is used, a separate sheathing membrane is not needed, provided the joints are sealed or lapped or tongue and groove and detailed to ensure proper drainage of water. Flashing must be installed beneath the insulating sheathing to ensure proper drainage.
(9.27.3.4.)

Note 2:
Where sheathing is omitted, two layers of sheathing membrane must be used beneath cladding.
(9.27.3.5.)

Figure 15.10
Brick Veneer Flashing and Weep Holes (9.20.13.) (9.27.3.)

Flashing installation practices around openings must conform to those in Figure 15.11. Flashing is not required under window and door openings located less than 150 mm (5-7/8") above grade.

Flashing may be omitted under window and door sills where these slope downward and are provided with a drip at least 25 mm (1") from the wall surface. Flashing may also be deleted beneath impervious, non-jointed masonry coping.

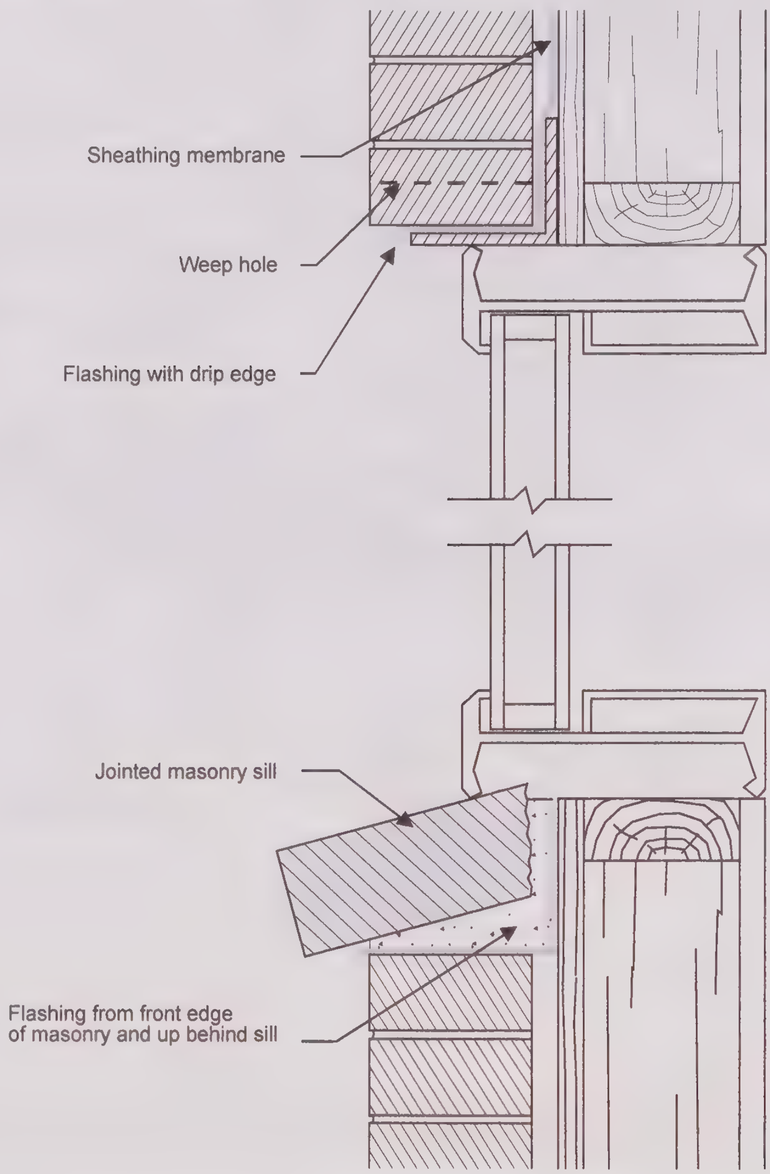


Figure 15.11
Location of Flashing Installed in Masonry Veneer Walls (9.20.13.3.)

GLASS BLOCK

BUILDING CODE REFERENCES

DIVISION B
9.20.2.3. Glass Blocks
9.20.3.2. Mortar Mixes
9.20.9.6. Reinforcing for Glass Block

Glass block must not be used as a loadbearing material or in the construction of fireplaces or chimneys. At present, the Code has no specific standard governing glass block. It does require, however, that the mortar mix must be Type S when exposed to the exterior and Type S or N when protected from the exterior. Refer back to Figure 15.3A for the mortar mix proportions for each Type.

Mortar joints must be reinforced either with two bars of corrosion resistant steel with a minimum 3.76 mm (5/32") diameter or expanded metal strips at least 75 mm (3") wide. All reinforcement must be continuous or lap at least 150 mm (5-7/8") within the mortar joint.

The installation of glass block must follow the general practices discussed in the previous section on masonry veneer.

Flashing must also be provided for glass block panels exposed to weather.

Cleaning excess mortar from glass must be done in progress. Any lumps that are dried on should be removed with a wood chisel, and not wire brushes or abrasive powders.

CLADDING

BUILDING CODE REFERENCES

DIVISION B

9.27.1.1.	General
9.27.2.1	Minimizing and Preventing Ingress and Damage
9.27.2.2.	Minimum Protection from Precipitation Ingress
9.27.2.3.	First and Second Planes of Protection
9.27.2.4.	Protection of Cladding from Moisture
9.27.3.1.	Elements of the Second Plane of Protection
9.27.3.4.	Insulating Sheathing in Lieu of Sheathing Membrane
9.27.3.5.	Sheathing Membranes in Lieu of Sheathing
9.27.3.6.	Face Sealed Cladding
9.27.3.7.	Flashing Materials
9.27.3.8.	Flashing Installation
9.27.4.1.	Required Sealants
9.27.4.2.	Materials
9.27.5.1.	Attachment
9.27.5.2.	Blocking
9.27.5.3.	Furring
9.27.5.4.	Size and Spacing of Fasteners
9.27.5.5.	Fastener Materials
9.27.5.6.	Expansion and Contraction
9.27.5.7.	Penetration of Fasteners
9.27.6.1.	Materials
9.27.6.2.	Thickness and Width
9.27.7.1.	Materials
9.27.7.2.	Width
9.27.7.3.	Fasteners
9.27.7.4.	Offsetting of Joints
9.27.7.5.	Fastening to Lath
9.27.7.6.	Exposure and Thickness
9.27.8.1.	Material Standards
9.27.8.2.	Thickness
9.27.8.3.	Edge Treatment
9.27.8.4.	Panel Cladding
9.27.8.5.	Lapped Strip Siding
9.27.9.1.	Material Standards
9.27.9.2.	Thickness
9.27.9.3.	Panel Cladding
9.27.9.4.	Lapped Strip Siding
9.27.9.5.	Clearance
9.27.10.1.	Material Standards
9.27.10.2.	Thickness
9.27.10.3.	Panel Siding
9.27.10.4.	Clearance
9.27.11.1.	Material Standard
9.27.12.1.	Material Standards
9.27.12.2.	Attachment
9.27.13.1.	Application
9.27.13.2.	Materials
9.27.13.3.	Design and Installation

Exterior cladding like other exterior finishes is primarily intended to protect the wall assembly from the entry of moisture. Each type of cladding finish requires specific accessories such as trim, sealants, supporting materials, flashing, and fasteners that allow the entire cladding system to fulfill its role.

Where asphalt shingles are used for cladding, they must also conform to the requirements as part of the asphalt shingle provisions of Chapter 8, Roofing, of this Guide.

General

In general, exterior walls need to be designed to minimize the entry of rain and snow into the assembly and into the interior space. Exterior walls should also be designed and constructed to resist damage from mechanical impact and from deterioration from sunlight (i.e. ultraviolet radiation).

All cladding materials that are easily damaged by excessive moisture exposure, such as wood-based materials, must not be installed within 200 mm (7-7/8") of the finished grade or within 50 mm (2") of the finished roof surface. Cladding materials not described in this Chapter must conform to the requirements of Part 5 of the Code.

Two Planes of Protection

Typically walls are designed and constructed with a cladding system that provides two planes of protection from incoming rain or snow. In most walls, the first plane of protection is provided by the exterior finish. The exterior finish includes the cladding (i.e. brick, siding, etc.) with the appropriate trim, accessory pieces and fasteners. The first plane acts to shed rain or snow that strike it. Wind-driven rain strikes the first plane of protection and loses much of its energy. The Code intends the first plane to manage the entry of water caused by kinetic energy (wind), surface tension, capillarity, gravity and air pressures. Water that is drawn into the wall past the first plane of protection is intercepted by the second plane of protection and directed to the exterior. Typically in dwelling units, a sheathing membrane often fulfills this function.

The second plane of protection consists of a drainage plane and flashing that can direct water to the outdoors. The sheathing membrane is normally installed over a sheathing, although two layers of sheathing membrane can also be used provided all joints in the sheathing membrane occur over framing and the membrane is fastened to the framing with roofing nails or staples spaced 150 mm (5-7/8") or less along the edges of the outer layer of sheathing paper.

In some cases, non-wood-based rigid exterior insulating sheathing or exterior insulating sheathing with an integral sheathing membrane installed can substitute for sheathing membrane. In these cases, the exterior insulating sheathing must have tongue and groove edges or its joints sealed or lapped to ensure drainage of water to the outdoors. Any sheathing panel that could deteriorate from exposure to moisture must be sealed at all joints.

Both the first and second plane of protection can also take the form of a face-sealed cladding or a metal cladding with locked-seam joints. Plywood, OSB, or fibre cement, for instance, can be installed without a sheathing membrane provided all edges of the cladding are supported by framing, vertical and horizontal joints are sealed and shiplapped, or are matched and weathertight. Vertical joints can also be sealed and covered with battens.

The first and second plane of protection must be maintained around all wall penetrations that result from services (e.g. plumbing, ducts, and electrical wiring), components (e.g. windows, doors) or intersecting wall assemblies. See Figure 15.12 on the following page.

Flashing

Flashing is required at:

- every horizontal junction between cladding elements except if the upper cladding laps overtop of the lower cladding by 25 mm (1") or more;
- every horizontal offset in the cladding;
- every horizontal line where different cladding substrate meet and where movement along the line might occur or where moisture drainage from behind the upper cladding might be compromised by the lower substrate.

Flashing is not required:

- where cladding above and below a joint is installed outboard of a drained and vented air space;
- where the joint detail is constructed to minimize the entry of rain into the airspace; or
- for stucco at the horizontal joint provided the joint is finished with an expansion-contraction strip and the stucco is installed outboard of a drained and vented air space.

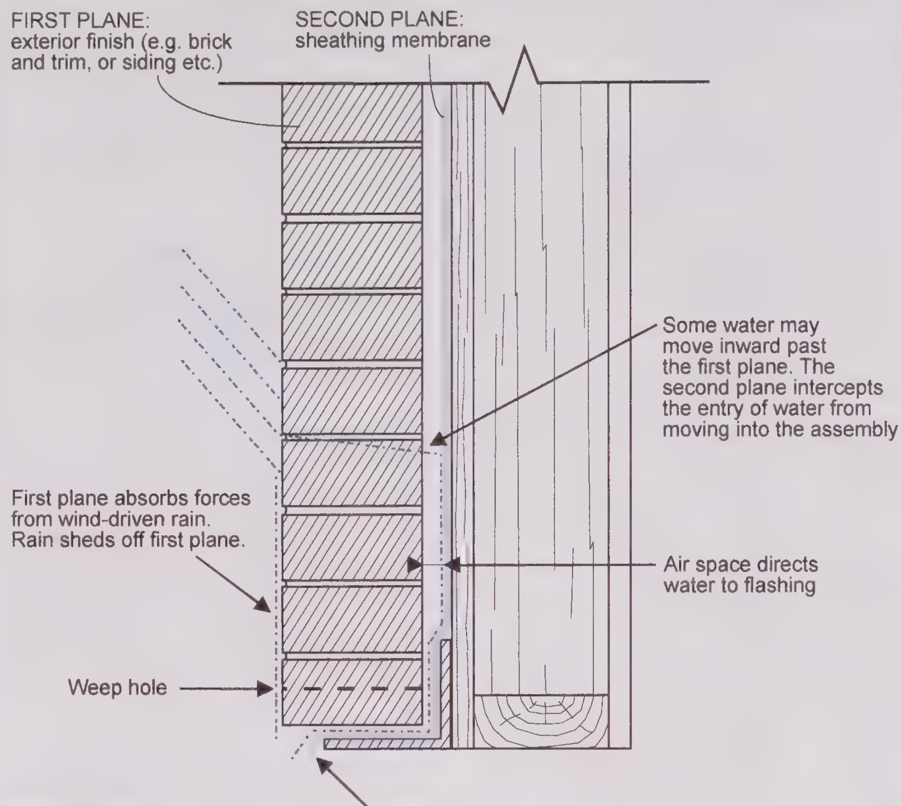


Figure 15.12
Two Planes of Protection (9.27.2.3.)

[illegible]

Allowable Materials	Minimum Thickness, mm (mil)
Lead	1.73 (68)
Galvanized Steel	0.33 (13)
Copper	0.46 (18)
Zinc	0.46 (18)
Aluminum	0.48 (19)
Vinyl	1.02 (40)

Figure 15.13
Flashing Materials (9.27.3.7.)

Flashing over window and door openings is not required if the distance from the top of the opening to the underside of the eave is less than 1/4 of the width of the eave projection, including eavestroughing, where provided. These openings, however, must have the exterior flange of the window or door frames securely fastened to the wall framing over a bead of non-hardening caulking to form a waterproof joint.

Window and door sills in exterior walls that are not self-flashing require flashing between the underside of the window or door and the wall below. Allowable flashing materials must conform to Figure 15.13.

Required flashing must:

1. Extend up and behind the sheathing membrane (or sheathing installed in lieu of a membrane) not less than 50 mm (2")
2. Have a slope not less than 6% towards the exterior after the expected shrinkage of the building frame
3. Terminate at an end dam with a height not less than 25 mm (1") and that extends to the face of the adjacent cladding
4. Lap not less than 10 mm (3/8") or more vertically over the building element below
5. Terminate in a drip extending 5 mm (3/16") or more beyond the outer face of the building element below.

The installation of head flashing over openings is shown in Figure 15.14.

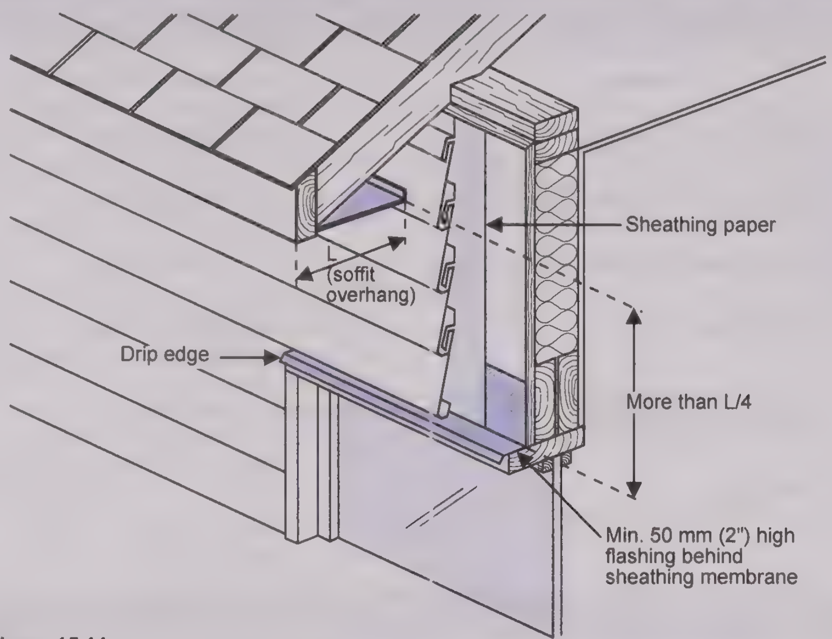


Figure 15.14
Flashing Placement beneath Cladding (9.27.3.8.)

Sealants

Sealants must be applied to those points through which moisture is likely to migrate and penetrate the wall assembly. All cladding including masonry and stucco must be sealed around window and door frames including the sills if they are not completely sheltered from the outdoors.

Vertical intersections between different cladding materials must be sealed and/or lapped to ensure that rain and snow cannot penetrate the wall assembly. Vinyl cladding producers recommend only lapping and no sealants as it may restrict expansion and contraction and may result in warping. Where sealants are used, sealant materials must be non-hardening, weather resistant and compatible with the cladding materials to ensure proper adhesion. See Article 9.27.4.2. of the Code for the material standards that govern sealants.

Minimum Sheathing Thickness for Exterior Finishes, mm (in)

Sheathing Material / Exterior Finish	Lumber	Plywood	Waferboard	OSB	Wood Lath
Vertical lumber siding	14.3 mm (5/8")	12.5 mm (1/2")	12.5 mm (1/2")	12.5 mm (1/2")	-
Vertical metal siding, vinyl siding and wood shingles and shakes	14.3 mm (5/8")	7.5 mm (1/4")	7.5 mm (1/4")	7.5 mm (1/4")	-
Wood shingles and shakes on wood lath	N/A	N/A	N/A	N/A	38 mm by 9.5 mm (2" by 3/8")

Figure 15.15
Sheathing Requirements for Exterior Finishes (9.27.5.1.)

Cladding Installation

If not attached to a sheathing material that conforms to the requirements depicted in Figure 15.15 on the previous page, cladding materials must be fastened directly to the framing, furring, or blocking members within the wall assembly. Blocking and furring used for the attachment of cladding materials must comply with Figure 15.16.

Fastener size and spacing must comply with Figure 15.17 to ensure a minimum standard for proper installation. The nails and staples used for fastening cladding must be corrosion resistant and compatible with the cladding material.

Fasteners and their installation for metal and vinyl cladding must allow for the expansion and contraction of these materials without creating any damage to the fasteners or the cladding.

Sizing of Furring and Blocking

Material	Size, mm (in)
Furring applied to sheathing [(1)]	19 x 38 (1 x 2)
Furring applied to supports 406 mm (16") o.c. [(2)]	19 x 64 (1 x 3)
Furring applied to supports 610 mm (24") o.c. [(2)]	19 x 89 (1 x 4)
Blocking in wall framing [(3)]	38 x 38 (2 x 2)

Note
(1) Does not pertain to wood lath shown in Figure 15.15.
(2) Spacing determined by siding attachment requirements but not greater than 610 mm (24").
(3) Blocking specifically intended to support siding.

Figure 15.16
Size of Furring and Blocking (9.27.5.2.) (9.27.5.3.)

Attachment of Cladding

Type of Siding	Min. Nail or Staple Length, mm (in)	Min. No. of Nails or Staples	Minimum Nail or Staple Spacing mm (in) o.c.
Wood trim	51 (2")	-	600 mm (23-5/8")
Lumber siding or horizontal siding made from sheet material	51 (2")	-	600 mm (23-5/8")
Metal cladding	38 (1-1/2")	-	600 mm (23-5/8") (nailed to framing) 400 mm (15-3/4") (nailed to sheathing only)
Wood shakes up to 200 mm (7-7/8") in width	51 (2")	2	-
Wood shakes over 200 mm (7-7/8") in width	51 (2")	3	-
Wood shingles up to 200 mm (7-7/8") in width	32 (1-1/4")	2	-
Wood shingles over 200 mm (7-7/8") in width	32 (1-1/4")	3	-
Panel or sheet type siding up to 7 mm (5/16") thick	38 (1-1/2")	-	150 mm (5-7/8") along edges
Panel or sheet type siding greater than 7 mm (5/16") thickness	51 (2")	-	300 mm (11-3/4") along intermediate

Note: Fasteners for shakes and shingles shall penetrate through the nail-holding base or supports not less than 19 mm (3/4") into the framing. Fasteners for other types of siding shall penetrate through the nail-holding base not less than 25 mm (1") into the framing

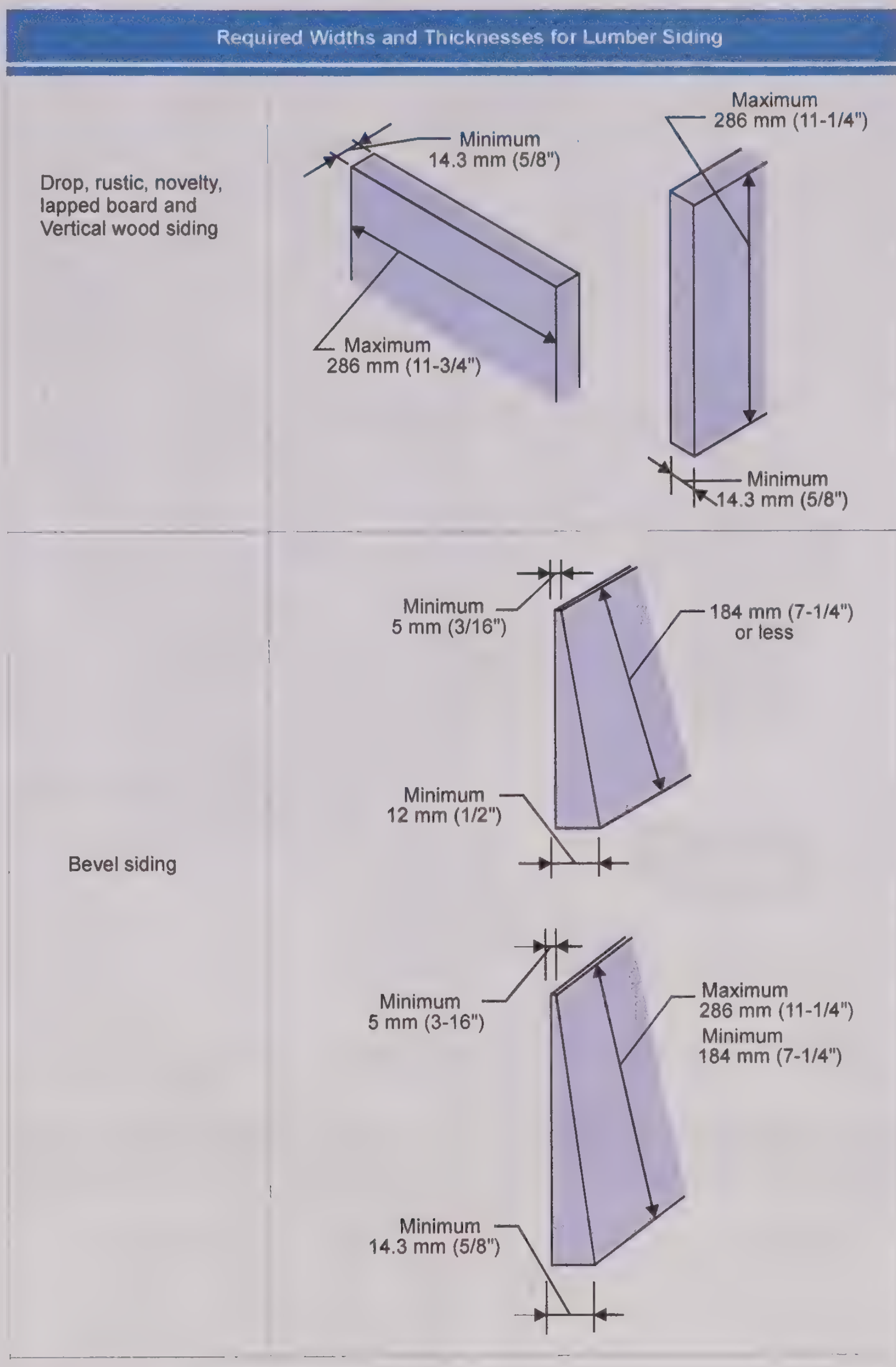
Figure 15.17
Attachment of Siding (9.27.5.4.)

Lumber Siding

All lumber siding finishes must be sound and free of knotholes, checks, splits, or any other defects that may affect the performance of the siding. Refer to Figure 15.18 for the required widths and thicknesses for lumber siding.

All joints in lumber siding should be installed to prevent the entry of rain and snow by lapping lumber pieces, matching joints (tongue and groove), or using vertical battens. These joints have minimum lapping widths that must comply with Figure 15.19.

Lumber siding shall not be installed within 200 mm (7-7/8") of the finished grade or within 50 mm (2") of the finished roof surface.



Figrue 15.18
Required Widths and Thicknesses for Lumber Siding (9.27.6.2.)

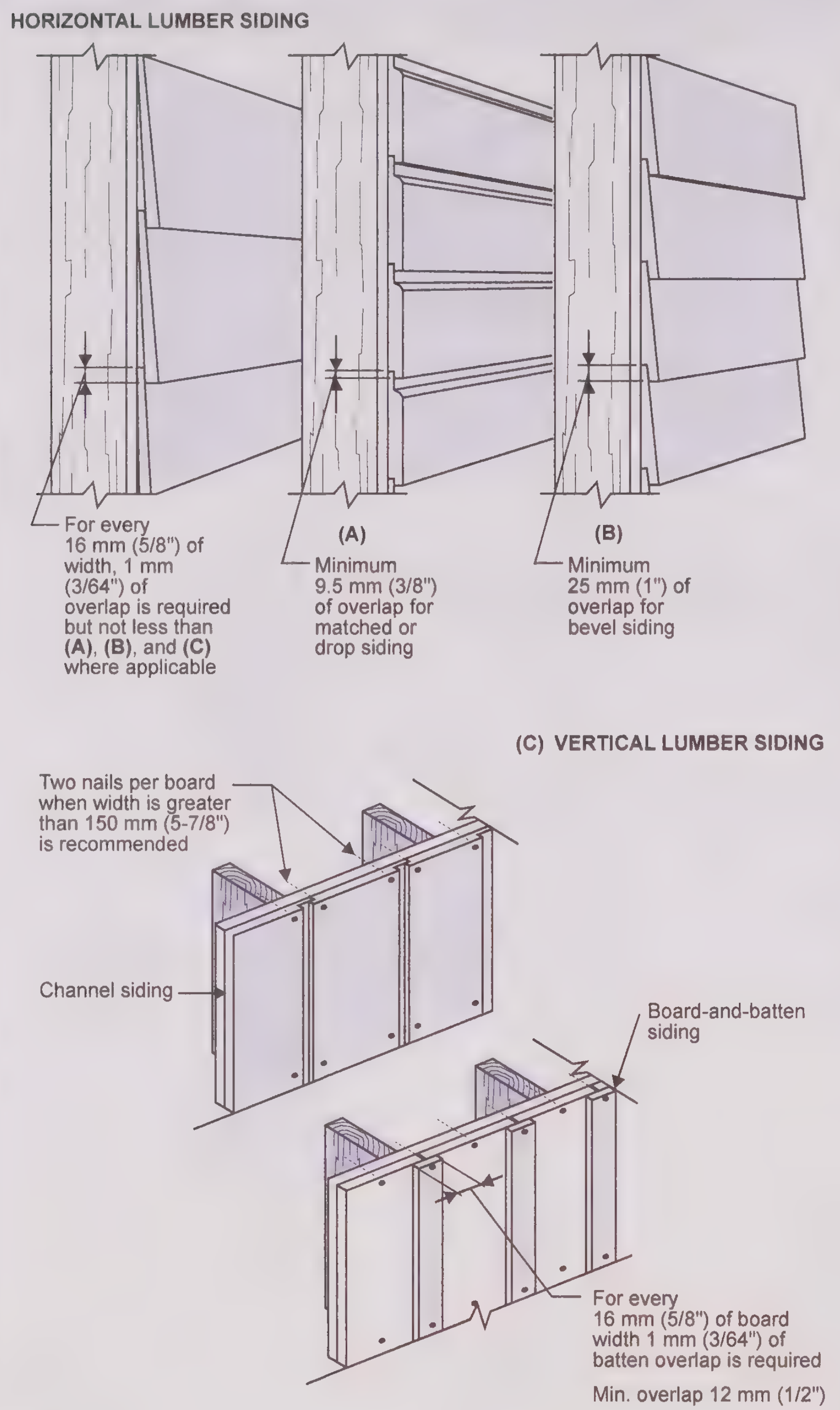


Figure 15.19
Lapping Widths for Lumber Siding Joints (9.27.6.3.)

Looking Back

Required Sheathing Beneath Siding.

Sheathing that serves as bracing must meet the sheathing requirements noted in Chapter 7, Wall Systems.

Wood Shingles and Shakes

All wood shingles and shakes are required to comply with the requirements shown in Figure 15.20 and with CSA O118.1, "Western Red Cedar Shakes and Shingles" or CSA O118.2, "Eastern White Cedar Shingles."

The size of wood shingles and shakes and applicable fastener requirements are shown in Figure 15.21. The allowable exposure of shakes and shingles may also be found here.

The offsetting of shakes and shingles courses must be such that any 2 of 3 successive courses are staggered at least 40 mm (1-9/16") in single course applications. A double course application requires that joints are staggered at least 40 mm (1-9/16") between outer courses and under courses as well as between successive courses. Refer to Figures 15.22 and 15.23 for an illustration of these requirements.

If a wood lath is used as described in Figure 15.15, it must be spaced according to the allowable exposure as shown in Figure 15.22. A double course application requires that the undercourse has the butt ends bear on the top edge of the lath. Nailing of the outer course must penetrate the lath and conform to Figure 15.17. Refer to Figure 15.24 for location requirements of courses.

Materials

Type of Wood	Minimum Grade
Western red cedar shakes	No. 1 Grade or Handsplit Grade
Western red cedar shingles	No. 2 Grade
Shingles used for undercoursing	No. 3 Grade
Eastern white cedar shakes	B Grade (clear)
Eastern white cedar shakes used for undercoursing	C Grade

Figure 15.20
Materials (9.27.7.1.)

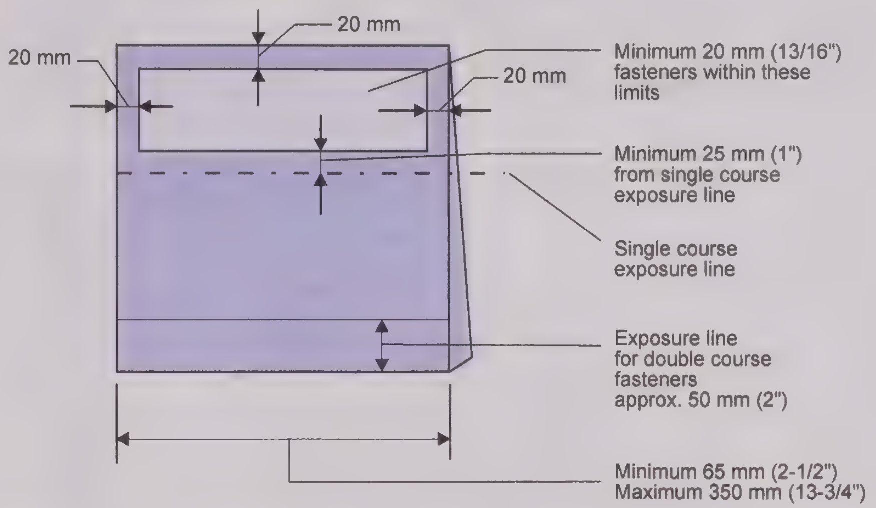


Figure 15.21
Applicable Fastener Requirements and Size of Wood Shingles and Shakes (9.27.7.2.) (9.27.7.3.)

Exposure and Thickness of Wood Shingles and Shakes

Shake or Shingle Length mm (in)	Maximum Exposure		Minimum Butt Thickness mm (in)
	Single Coursing mm (in)	Double Coursing mm (in)	
400 mm (15-3/4")	190 mm (7-1/2")	305 mm (12")	10 mm (3/8")
450 mm (17-3/4")	216 mm (8-1/2")	356 mm (14")	11 mm (7/16")
600 mm (23-5/8")	292 mm (11-1/2")	406 mm (16")	13 mm (1/2")

Figure 15.22
Exposure and Thickness of Wood Shingles and Machine Grooved Shakes (9.27.7.6.)

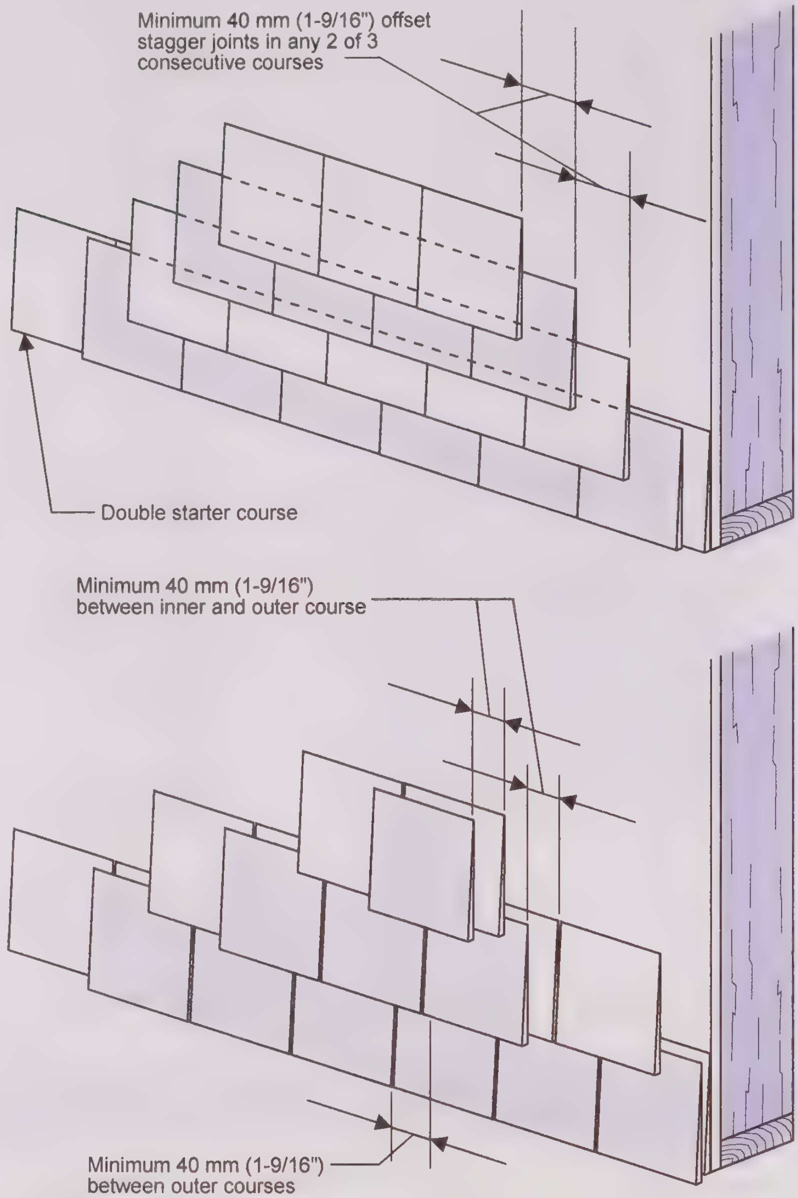


Figure 15.23
Shakes and Shingles (9.27.7.4.)

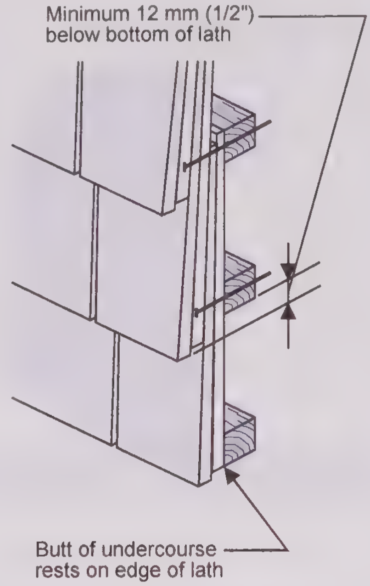


Figure 15.24
Lath Spacing (9.27.7.5.)

Plywood and Hardboard

Exterior plywood finish must comply to the standards listed in Section 9.27.9. of the Code. The thickness of exterior plywood must conform to the values shown in Figure 15.25. It is important to check that all edges are sealed with a primer or shellac to protect the inner plies from exposure. It is highly recommended that all plywood be back primed to ensure complete protection of the material.

Hardboard exterior finishing must comply with CAN/CGSB 11.5M, "Hardboard, Pre-coated, Factory Finished for Exterior Cladding" for factory finished panels and with CAN/CGSB 11.3, "Hardboard" for unfinished panels that are either Type 1, 2, or 5. The minimum thickness of hardboard exterior finishing must comply with values listed in Figure 15.26.

Plywood may be used for wall finishing or soffit applications, but must always have all the edges supported. All panels and lapped strips are required to be spaced at least 2 mm (3/32") between edges and butted ends. Vertical joints must be protected with a batten strip or sealants if the panels are not tongue and groove type. Horizontal joints must be lapped at least 25 mm (1"), or suitably flashed. These requirements are illustrated in Figure 15.27 on the following page.

Plywood lapped strip siding that is applied without sheathing requires that wedges are fit in snugly between the framing and the boards at vertical butt joints and corners to prevent any rain penetration.

Hardboard must follow the same installation requirements as plywood in Figure 15.27, except that the edges and butted ends must be spaced at least 5 mm (3/16") and must be protected with sealants, battens, or other types of mouldings. Horizontal lapped hardboard strips must be lapped at least 1 mm (1/32") for every 16 mm (5/8") of strip width and a minimum of 9.5 mm (3/8") for matched strips and 25 mm (1") for normal lapped boards.

A clearance of 3 mm (1/8") is required between all hardboard finishes and window and door frames. These clearance gaps should be caulked or protected with a batten or moulding.

Minimum Plywood Thickness, Exterior Wall Finish

Spacing of Supports mm (in)	**Face Grain Parallel to Supports** mm (in)	**Face Grain at Right Angles to Supports** mm (in)
Continuous sheathing	6 mm (1/4")	6 mm (1/4")
406 mm (16")	8 mm (5/16")	6 mm (1/4')
610 mm (24")	11 mm (7/16")	8 mm (5/16")

Note: the thickness of grooved or textured plywood shall be measured at the point of least thickness

Figure 15.25
Minimum Plywood Thickness (9.27.8.2.)

Minimum Thickness of Hardboard, mm (inches)

Grading / **Support**	**Continuous Supported Sheathing**	**Framing Max. 406 mm (16") o.c.**
Type 1 or 2	6.0 mm (1/4")	7.5 mm (5/16")
Type 5	9.0 mm (3/8")	9.0 mm (3/8")

Note: Grooved Finished Panels must not have grooves deeper than 1.5 mm (1/16") into the minimum required thickness

Figure 15.26
Minimum Thickness of Hardboard (9.27.9.2.)

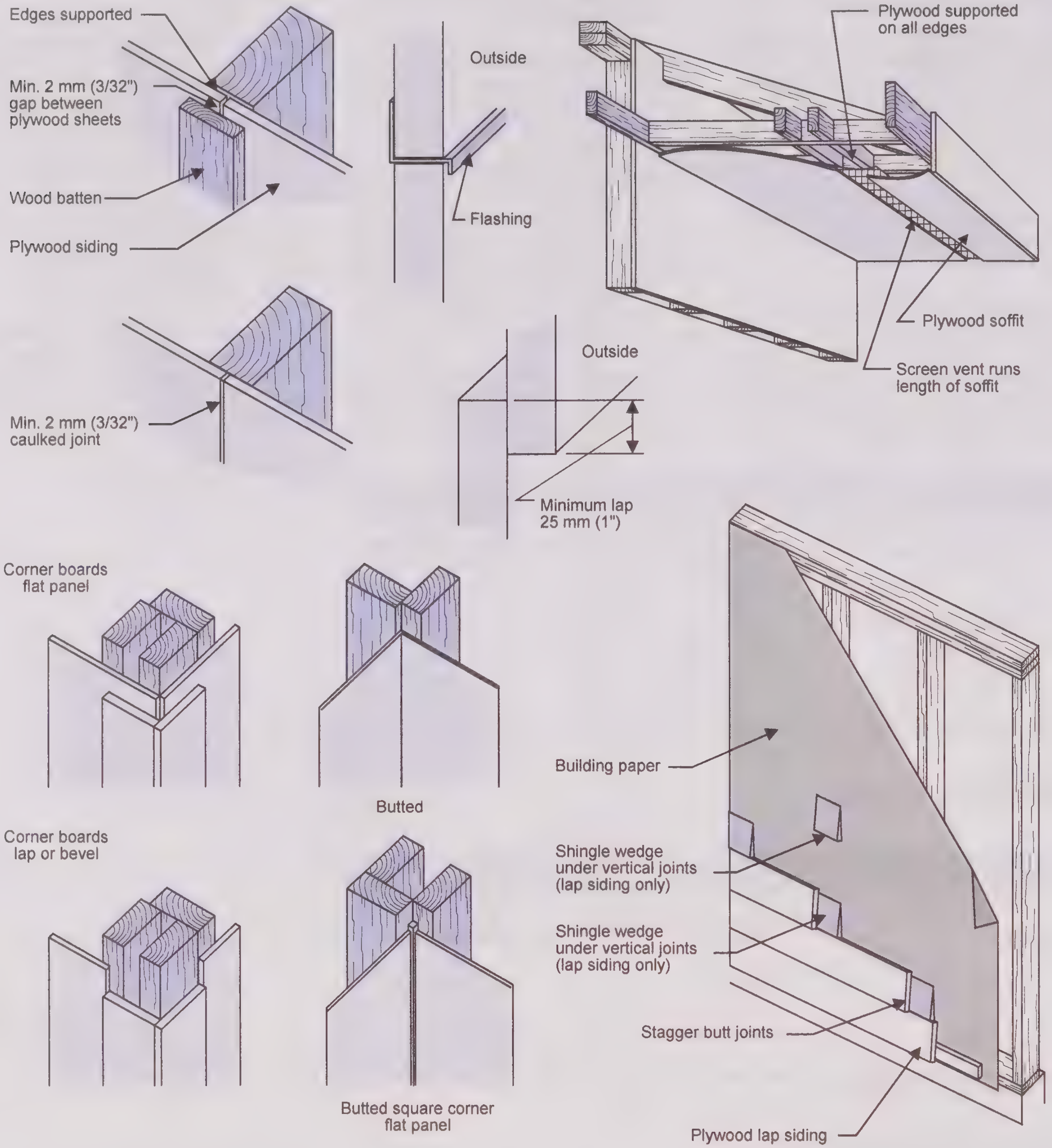


Figure 15.27
Vertical and Horizontal Joints for Plywood

(9.27.8.)
(9.27.9.)

Minimum Thickness of Waferboard and OSB, mm (in)

Grades	Continuously Supported Sheathing	Framing	
		Max. 406 mm (15-3/4") o.c.	Max. 610 mm (23-5/8") o.c.
O-2 Face orientation parallel to support	6 mm (1/4")	8 mm (5/16")	11 mm (3/8")
O-2 Face orientation perpendicular to support	6 mm (1/4")	6 mm (1/4")	8 mm (5/16")
R-1 and O-1	7.9 mm (5/16")	9.5 mm (3/8")	12.7 mm (1/2")

Figure 15.28
Thickness of Waferboard and Strandboard (9.27.10.2.)

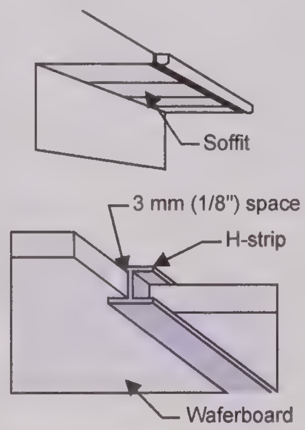


Figure 15.29
H-Strips (9.27.10.3.)

Better Building Note

All edges for boards used in exterior applications must be sealed with a primer or shellac.

Back priming is highly recommended for assurance of the sealing of these moisture sensitive materials.

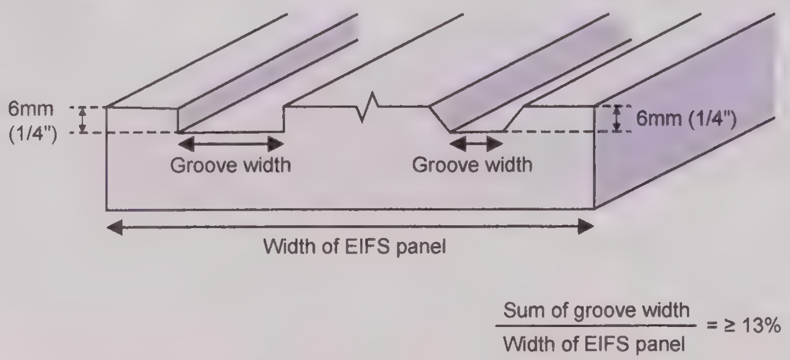


Figure 15.30
Geometrically Defined Drainage Cavity (9.27.13.1.)

Waferboard and OSB

All waferboard and OSB exterior finishes must conform to CAN3-O437.0, "OSB and Waferboard." The Code requires that the minimum thickness of waferboard and OSB conform to the requirements of Subsection 9.27.11. All allowable waferboard and OSB thickness are listed in Figure 15.28. Note that the consideration for the direction of the face grain is altered to the direction of the face orientation.

Exterior finished boards must have a 3 mm (1/8") space between all edges. Boards that are lapped must be done so with at least a 25 mm (1") overlap. Horizontal flush joints must be flashed in the same manner as plywood and hardboard. Vertical joints must be caulked, or protected with battens or suitable mouldings. Refer to the Figure 15.27.

Waferboard and OSB may be used for soffits and exterior ceiling applications. It is suggested that clips are used for joints to ensure that the level of each board is consistent with the next as shown in Figure 15.29.

Exterior Insulation Finish Systems

Provisions for Exterior Insulation Finish Systems (EIFS) will come into effect on January 1, 2015. The materials, design, and installation of EIFS must be in accordance with a number of standards. They are required to have a defined drainage cavity that measures 6 mm (1/4") in depth that creates an open area of not less than 13% of the area of a full panel, see Figure 15.30. EIFS are required to be installed on a substrate material that is compatible with the EIFS, and also complies with the sheathing requirements of the Code.

Metal and Vinyl

Figure 15.30 illustrates the requirements for metal and vinyl cladding. Installation of cladding must still comply with Subsections 9.27.3. Flashing, 9.27.4. Caulking, and 9.27.5. Attachment of Cladding. Vinyl cladding must conform to CAN/CGSB-41.24, "Rigid Vinyl Siding, Soffits and Fascia". Standards governing metal and vinyl cladding materials may be found in Section 9.27. of the Code.

For nailing procedures for vinyl cladding, see Figure 15.31.

Thickness of Steel and Aluminum Sheet Cladding

Metal Siding	Minimum Thickness mm (mil)	Governing Standards
Horizontal and vertical strip steel cladding (including flashing and trim accessories)	-	CAN/CGSB - 93.4-M
Sheet steel	0.30 mm (12 mil)	CAN/CGSB - 93.3-M
Horizontal and vertical strip aluminum	-	CAN/CGSB - 93.2-M
Sheet aluminum	0.58 mm (23 mil)	CAN/CGSB - 93.1-M
Sheet aluminum on continuous supported sheathing	0.46 mm (18 mil)	CAN/CGSB - 93.1-M

Figure 15.31
Thickness of Steel and Aluminum Sheet Cladding (9.27.11.1.)

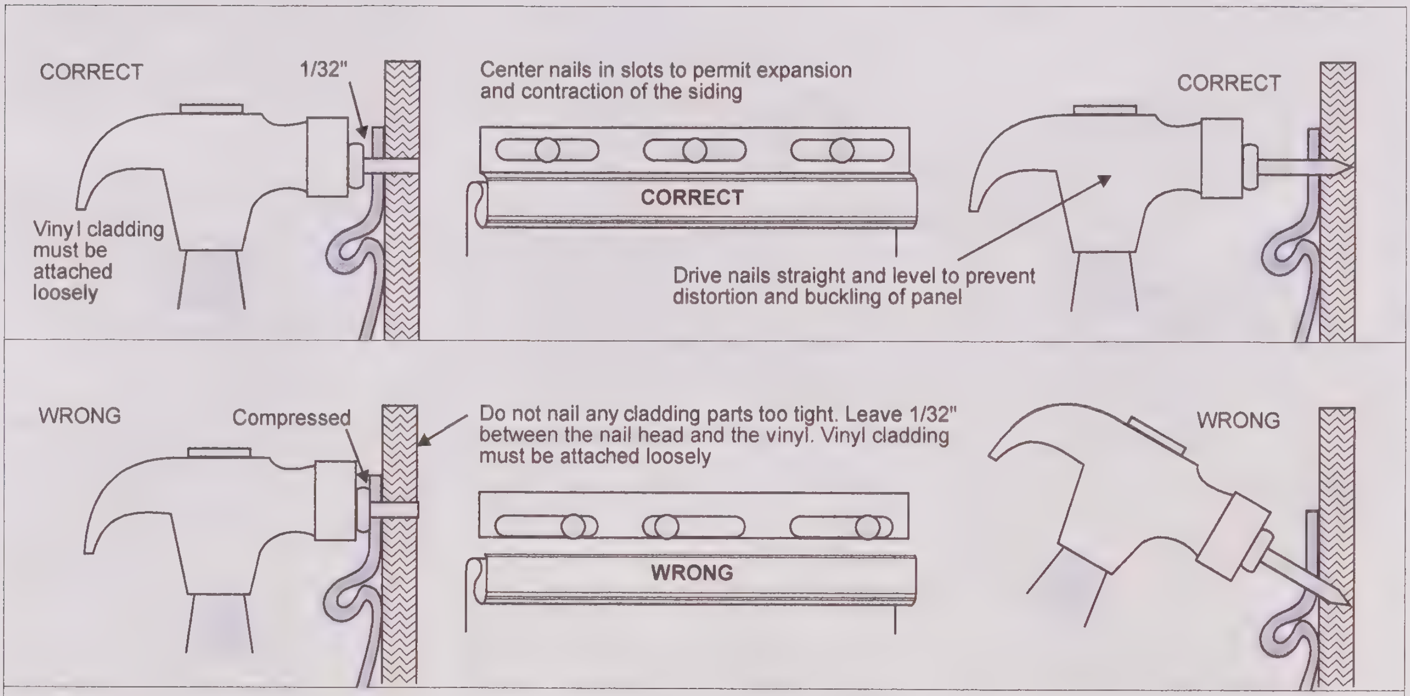


Figure 15.32
Nailing Procedure for Vinyl Cladding

STUCCO FINISHES

BUILDING CODE REFERENCES

DIVISION B

9.28.1.1.	Sheathing Beneath Stucco
9.28.1.2.	Lath and Reinforcing
9.28.1.3.	Concrete Masonry Units
9.28.1.4.	Clearance over Ground Level
9.28.1.5.	Flashing and Sealants
9.28.2.1.	Portland Cement
9.28.2.2.	Aggregate
9.28.2.3.	Water
9.28.3.1.	Materials
9.28.3.2.	Nails and Staples
9.28.4.1.	Materials
9.28.4.2.	No Sheathing Required
9.28.4.3.	Stucco Lath Specifications
9.28.4.4.	Self-Furring Devices
9.28.4.5.	Application of Stucco Lath
9.28.4.6.	Fastening
9.28.5.1.	Mixes
9.28.5.2.	Pigments
9.28.5.3.	Mixing
9.28.6.1.	Low Temperature Conditions
9.28.6.2.	Number of Coats and Total Thickness
9.28.6.3.	First Coat
9.28.6.4.	Second Coat
9.28.6.5.	Finish Coat

Requirements for exterior stucco finishes are presented in this section. It is important that all requirements for stucco application are observed to ensure a durable, well performing finish. Additional information is available in the Portland Cement Association document "Portland Cement Plaster (Stucco) Manual". This section does not address Exterior Insulation Finishing Systems (EIFS) from Minister's Rulings approving CCMC Evaluations, or the requirements outlined in Subsection 9.27.13.

General

Stucco must have a grade clearance of at least 200 mm (7-7/8"), except where applied to concrete or masonry. Concrete block units must be at least 1 month old before stucco is applied to them unless the block has been cured by the autoclave process.

Stucco should not be confused with parging. The requirements for parging of foundations may be found in Chapter 2 of this Guide or in Section 9.13, Parging and Finishing in the Code.

All flashing and sealants where required must conform to Subsections 9.27.3. Flashing and 9.27.4. Sealants of the Code. Aluminum flashing must be protected by an impermeable coating or substrate to ensure it will not corrode due to exposure to the stucco.

Stucco must be applied at a working temperature of at least 10°C (50°F) during application and for at least 48 hours afterwards. The base coat must be kept from freezing.

Stucco Lath and Fasteners

Lath and reinforcement must be used for the attachment of stucco to wood-frame walls.

Required thickness of sheathing materials depends on support spacing and must conform to values listed in Figure 15.32.

Sheathing must be provided beneath stucco applied over wood-frame walls unless a 1.19 mm (1/16") diameter galvanized wire is applied horizontally to the framing with a vertical spacing of no more than 150 mm (5-7/8"), or paper-backed welded wire lath is installed.

Where required, sheathing paper must be asphalt impregnated. Tar saturated building paper should not be used.

Masonry walls must be at least the same strength as the stucco and sufficiently rough to guarantee the adhesion of the stucco.

Stucco lath must be used to attach stucco to soft burned tile or brick, if the masonry is of less strength than the stucco. Stucco lath must also be used if the masonry surface is not sound, clean, or if it will not provide an adequate key for the stucco. Stucco applied over masonry chimneys must be reinforced.

All stucco lath and reinforcing must be attached with corrosion resistant fasteners that conform to the requirements outlined in Figure 15.33. Rib lath or metal mesh must be copper-alloy steel that is either painted with corrosion resistant paint or galvanized. Woven and welded wire mesh must be galvanized. Stucco lath materials must conform to the required properties listed in Figure 15.34. Stucco lath must be spaced at least 6 mm (1/4") from backing materials with spacers or other such self-furring devices.

Minimum Sheathing Thickness

Lumber mm (in)	Plywood, OSB, Waferboard mm (in)
14.3 mm (5/8")	12.5 mm (1/2")
14.3 mm (5/8")	12.5 mm (1/2")

Note:
Sheathing is not required beneath stucco where at least 1.19 mm (0.047") diameter galvanized wire at (max.) 150 mm (5-7/8") vertical intervals are applied horizontally, or where paper-backed welded wire metal lath is used (9.28.4.2.)

Where stucco lath is fastened to sheathing, the sheathing must meet the thickness requirements of this table.

Figure 15.33
Minimum Sheathing Thickness for Stucco Lath (9.27.5.1.)

Fastener Requirements for Stucco Lath or Reinforcing

Requirements	Nails: Min. Shaft Diameter mm (in)	Nails: Min. Head Diameter mm (in)	Staples mm (in)
Fasteners Shaft Diameter Size	3.2 mm (1/8")	11.1 mm (7/16")	1.98 mm (0.078")
Minimum Penetration into Vertical Framing	25 mm (1")		25 mm (1")
Minimum Penetration into Horizontal Framing	38 mm (1-1/2")		38 mm (1-1/2")

Figure 15.34
Fastener Requirements for Stucco Lath or Reinforcing (9.28.3.2.)

Stucco Lath Specifications

Location	Type of Lath	Min. Diam. of Wire mm (in)	Max. Mesh Opening	Min. Mass kg/m² (lb/ft²)
Vertical surfaces	Welded or woven wire	1.15 mm (0.045") 1.30 mm (0.051") 1.50 mm (0.059")	25 mm (1") 38 mm (1-1/2") 51 mm (2")	- - -
	Stucco mesh reinforcing (expanded metal)	-	25.8 cm² (4 in²)	0.98 (0.20)
Horizontal surfaces	9.5 mm (3/8") rib lath	-	-	1.84 (0.38)
	Cedar lath	-	-	-

Figure 15.35
Stucco Lath Specifications (9.28.4.3.)

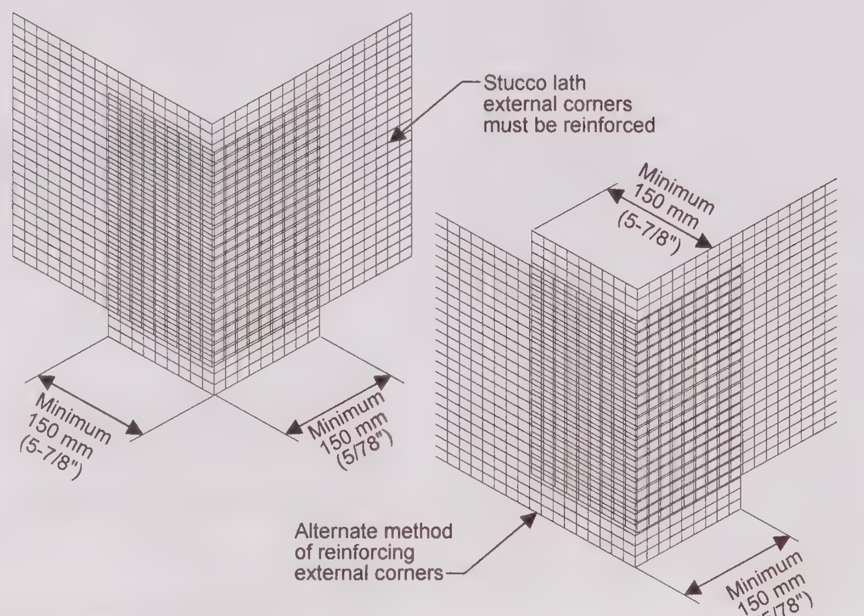


Figure 15.36
Reinforcing External Corners (9.28.4.5.)

Stucco lath must be attached lengthwise across framing and joints in the lath must be lapped at least 50 mm (2"). These laps must be staggered between lath courses and applied directly over framing members. External corners must be reinforced as shown in Figure 15.35.

Fasteners must be spaced in accordance with Figure 15.36. In all assemblies, stucco lath must have at least 20 fasteners for every square meter (10 square feet) if a different nailing or stapling pattern from that shown is used.

Spacing Fasteners for Vertical and Horizontal Framing, mm (in)		
	Method 1	Method 2
Max. Vertical Spacing	150 mm (5-7/8")	100 mm (4")
Max. Horizontal Spacing	406 mm (16")	610 mm (24")

Figure 15.37
Spacing Fasteners for Vertical and Horizontal Framing (9.28.4.6.)

Aggregate Grading for Stucco		
Sieve Sizes mm (in)	Percent Aggregate Passing Sieve	
	Maximum	Minimum
4 (0.157)	-	100
2 (0.079)	-	90
1 (0.039)	90	60
0.5 (0.020)	60	45
0.25 (0.010)	30	10
0.125 (0.005)	5	-

Figure 15.38
Aggregate Grading for Stucco (9.28.2.2.)

Materials, Volume			
Portland Cement	Masonry Cement Type H	Lime	Aggregate
1	-	0.25 to 1	3.25 to 4 parts per part
1	1	-	of cementitious material

Figure 15.39
Materials, Volume (9.28.5.1.)

Stucco Materials

Stucco aggregate for mixing must be clean, properly graded, free of any significant contaminating material, and graded in accordance with the values listed in Figure 15.37. The aggregate can be either natural sand, manufactured from crushed stone, gravel, or air-cooled blast furnace slag. Portland cement used in mixing must conform to CAN/CSA-A3001, "Cementitous Materials for Use in Concrete". Ensure the water that is used is clean.

Stucco Mixes

Stucco materials must be mixed using the proportions described in Figure 15.38. Any pigment added to the stucco must consist of pure mineral oxides that will not react with sunlight, lime or cement. Pigment must not exceed 6% of the Portland cement by weight.

All stucco materials must be thoroughly mixed before and after adding water. Stucco must be applied within 3 hours of the initial mixing.

Stucco Application

Stucco must be applied with at least 2 base coats and 1 finish coat that will result in a total thickness of not less than 15 mm (5/8") from the face level of the lath or the masonry as shown in Figure 15.40.

The first coat must be at least 6 mm (1/4") thick from the face of the lath or masonry in a fairly level consistency and then keyed to provide a rough base for the following coat. The lath must be fully embedded within the first coat.

The second coat must also be at least 6 mm (1/4") thick and lightly roughened to guarantee good adhesion for the final coat, unless the finish coat is stone dash, in which case the second coat may be smooth finished.

The finish coat must be at least 3 mm (1/8") thick. The second coat must be dampened, but not soaked, before the final coat is applied. For a stone dash finish, the stones must be partially embedded in the second coat before it starts to set or stiffen.

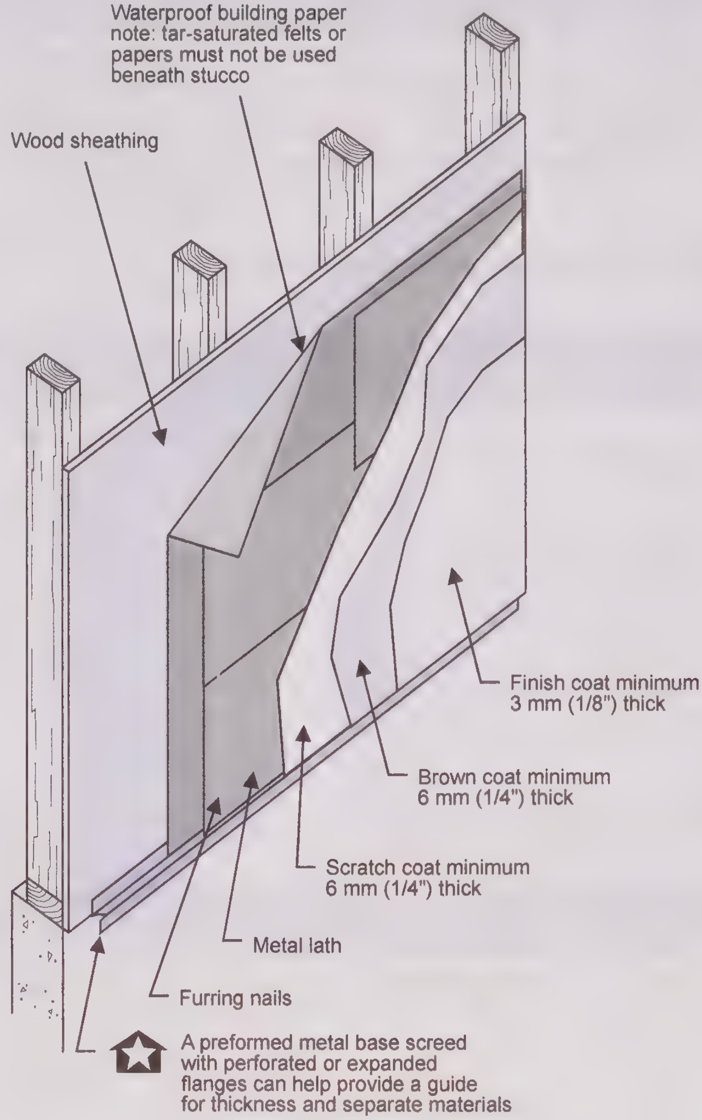


Figure 15.40
Stucco Application - Number of Coats and Thickness (9.28.6.)

16 GARAGES, CARPORTS, AND DECKS

Garages and carports represent forms of building construction which are not intended to meet the same Code requirements as dwelling units. Garages and carports which are attached to dwelling units, however, have additional requirements. Decks are not explicitly referenced in the Code; however, some guidelines and recommended practices have been included in this Chapter.

KEY POINTS

Garages and carports must be designed and constructed to fulfill the following functions:

- transfer structural loads to the surrounding soils and;
- provide a gas-proof seal between attached or built-in garages and the dwelling unit.

GARAGES AND CARPORTS

BUILDING CODE REFERENCES

DIVISION B

9.3.1.6.	Compressive Strength
9.3.1.7.	Concrete Mixes
9.10.13.15.	Doors Between Garages and Dwelling Units
9.35.1.1.	Application
9.35.1.2.	Construction Requirements
9.35.2.1.	Carport Considered to be Garage
9.35.2.2.	Garage Floor
9.35.3.1.	Foundation Required
9.35.3.2.	Protection from Damage due to Soil Movement
9.35.3.3.	Small Garages
9.35.3.4.	Column Piers
9.35.4.1.	Interior Finish
9.35.4.2.	Columns
9.35.4.3.	Anchorage

Garages and carports are not intended for the type of occupancy associated with a dwelling unit. The Code's requirements, therefore, focus on structural safety, and in the case of attached or connected garages and carports, their influence on the safety and integrity of the main dwelling itself.

GENERAL

The requirements of the Code's Section 9.35. apply to all garages and carports. While garage and carport construction must conform with the requirements applicable to all buildings in the Code, Section 9.35. does include some exceptions.

Garages may be distinguished from carports based on the criteria illustrated in Figure 16.1. A garage is distinguished from a carport when it has more than 60% of the total perimeter enclosed by walls, windows or doors.

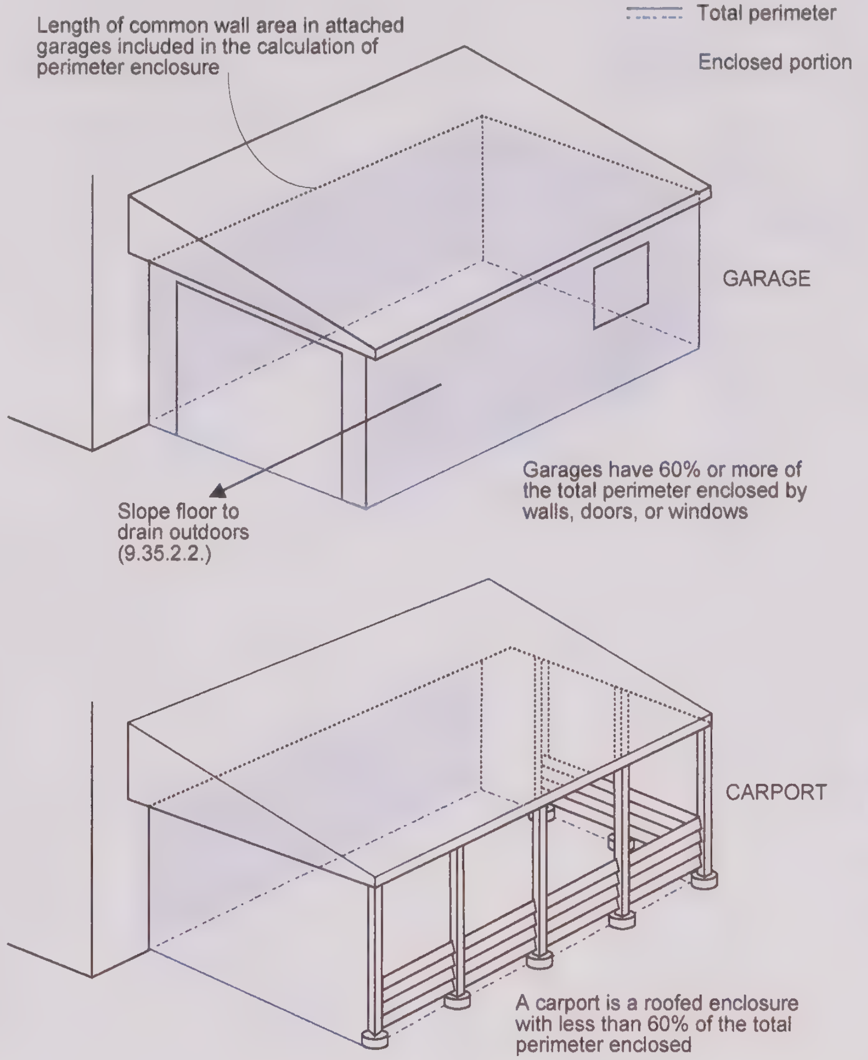


Figure 16.1
Definition of a Garage and a Carport (9.35.2.1.)

Foundations and Floors

Foundations for garages and carports must conform to the requirements in Section 9.12. and 9.15. of the Code except as described below.

Accessory buildings (including garages) with a floor area of 55 m² (592 ft²) or less are not required to have a below grade foundation, provided the building is not of masonry or masonry veneer construction, and is not more than one storey in height. Refer to Subsection 9.35.3.

Garage or carport walls and columns must be anchored to the foundation to resist wind uplift in accordance with the requirements of Subsection 9.23.6. of the Code, except that in the case of ground supported structures, such as small garages, ground anchors must be supplied. Refer to Articles 9.35.4.2. and 9.35.4.3.

Garages less than 55 m² (592 ft²) in floor area could be supported on mud sills but must be ground anchored to resist wind uplift pressure. Figure 16.2 illustrates these requirements.

Foundation depths for attached unheated garages or carports must conform to the requirements of Subsection 9.12.2. of the Code. Sentence 9.12.2.2.(6) permits foundation depths other than provided for normally.

In clay-type soils susceptible to significant movement resulting from changes in moisture content, the foundation depth of garages or carports connected to a dwelling unit by a breezeway must be approximately the same as the main building foundation (Figure 16.3). This requirement is intended to minimize differential movement.

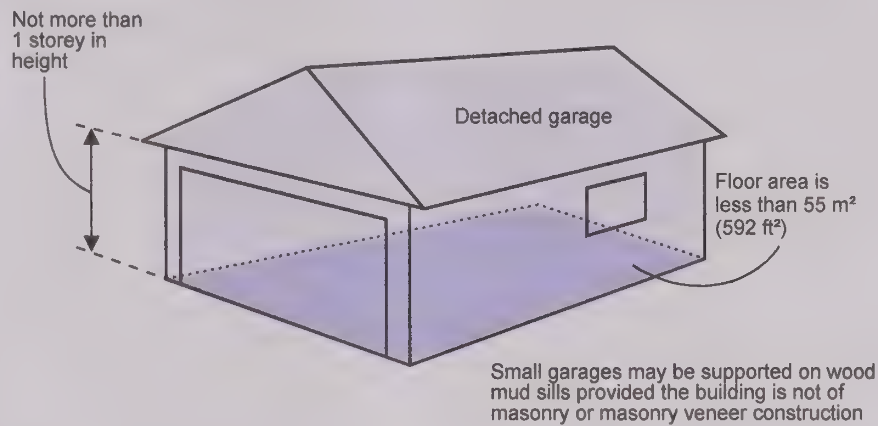


Figure 16.2
Small Garage Requirements
(9.12.2.2.)
(9.35.3.3.)

Full Depth Foundations in Clay Type Soils

Foundation depth of garages or carports connected to a dwelling by a breezeway must be approximately the same depth as the main building foundation

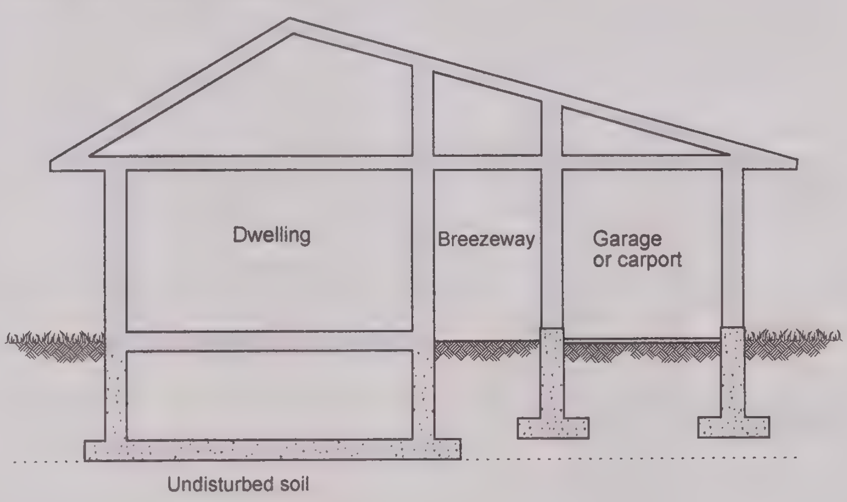


Figure 16.3
Protection from Damage Due to Soil Movement
(9.35.3.2.)

Piers used to support carport columns must extend a minimum of 150 mm (5-7/8") above ground level and project not less than 25 mm (1") beyond the base of the column. Piers must be not less than 190 mm x 190 mm (7-1/2" x 7-1/2"). Refer to Figure 16.4 for a summary of these requirements.

Soil gas control is not required for garages or other unenclosed parts of buildings. Where slab-on-ground construction is used, a construction joint must be provided between the main building slab and the garage or breezeway for all soil types.

Floors in all attached or built-in garages must be sloped to drain liquids to the outdoors. See Clause Sentence 9.35.2.2.(1).

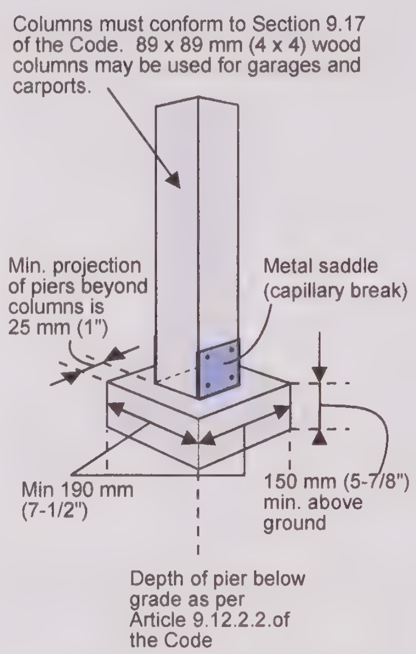


Figure 16.4
Column Piers for Carports (9.35.3.4.) (9.35.4.2.)

Walls and Columns

Interior finishes are not required for garage and carport walls except when fire resistance ratings are required. Columns in garages and carports must conform to the requirements of Section 9.17. of the Code, except that 89 mm x 89 mm (4 x 4) wood columns may be used. Refer to 9.35.4.2. and 9.35.4.3.

Doors Between Garages and Dwelling Units

Doors between dwelling units and garages must be closely fitted and weather-stripped to reduce the likelihood that fumes and gases leak into the house. These doors must also be provided with a self-closing device to protect the occupants from these fumes. A door from a bedroom cannot open into a garage. It is very important that these provisions for doors between a dwelling unit and an attached garage are observed. Ensure that the walls and ceilings separating the dwelling from the garage are also sealed to prevent leakage. Refer to Figure 16.5.

Factory assembled doors in storage garages may include foamed plastic insulation having a flame spread rating of not more than 500, where the insulation is covered on the interior with a metallic foil, the surface assembly has a flame spread rating of not more than 200, and the assembly incorporates no air spaces.

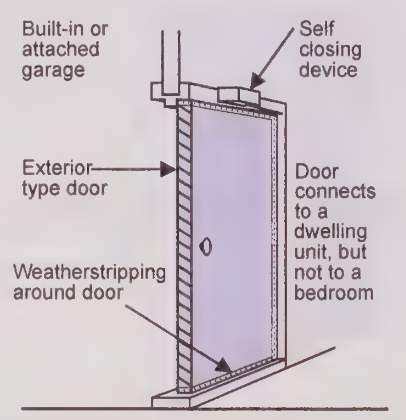


Figure 16.5
Doors Between Attached or Built-In Garage and Dwelling Unit (9.10.13.15.)

Better Building Note

Garage Floor Slabs

The Code requires that concrete slabs-on-grade for garages or carports be supported on undisturbed soil. Material that is susceptible to changes in volume due to variations in moisture content or chemical-microbiological oxidation shall not be used as fill beneath floors-on-ground in a concentration that will damage the building. Material that is susceptible to changes in volume due to freezing shall not be used as fill beneath floors-on-ground that will be subjected to freezing temperatures. For site mixed concrete, the minimum compressive strength of the concrete must be 32 MPa (4650 psi) after 28 days, and it must have 5-8% air entrainment. Fill beneath floors-on-ground need not be compacted where the material is clean coarse aggregate containing not more than 10% of material that will pass a 4 mm (5/32") sieve. The ratio of water to cementing materials for sitebatched concrete mixes must not exceed 0.45. Pre-mixed concrete must comply with CAN/CSA A438 as required in 9.3.1.1.(1).

The following measures represent better building practice aimed at alleviating spalling and shrinkage cracks.

1. Place concrete slabs on a well compacted layer of granular material, 100 to150 mm (4 to 5-7/8") in depth.

2. If a surface sealer is to be applied to the concrete, install a moisture barrier beneath the slab to reduce the potential for spalling.

3. Provide construction joints in the slab to control cracking.

4. Check that all concrete is of required strength and air entrainment and allow the concrete to fully cure before permitting the parking of vehicles.

5. Provide steel mesh to control cracking

6. Never allow water to be added to concrete mix.

The practice of installing grade-beams in garages can only be permitted if they are designed appropriately and the design is approved by the municipality.

Decks

Decks are a common outdoor extension of the dwelling unit. As such, decks must be designed and constructed to safely support imposed loads. All general requirements for wood frame construction also apply to wooden decks.

Ideally, first and second storey decks shold be supported independently of the building. Decks attached to the dwelling unit must be designed to withstand movement or to prevent damage to the dwelling should movement occur. If a deck is more than 600 mm (23-5/8") off the ground, a guard is required. If a bench is incorporated into the guard the required height is measured above the bench surface. Stairs, railings, and guards must comply with applicable Code requirements. Refer to Chapter 5 of the Guide, Section 9.8 of the Code, and Supplementary Standard SB-7 for stairs, railings, and guard requirements.

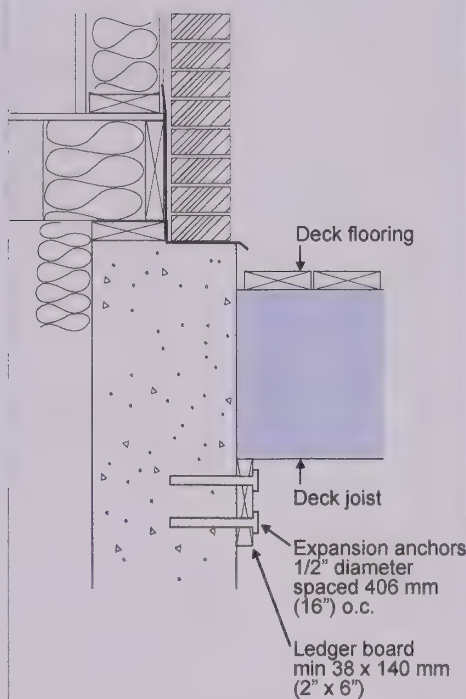
Check with the local municipality to confirm pier sizing and spacing. Pier size and depth depends on the bearing capacity of local soil conditions. Check beam sizes and joist spacing on snow loading for your area. Balconies, decks and other accessible exterior platforms intended for an occupancy and subject to snow loads shall be designed to carry the specified roof snow load or 1.9 kPa (40 psf), whichever is greater, where the platform, or each segregated area of the platform, serves a single dwelling unit.

Where pressure treated lumber is used for decks, the treated wood must conform to the appropriate Use Category in CAN/CSA-O80.1, "Specification of Treated Wood" as described in Article 9.3.2.9. Framing member sizes must be increased to accomodate wet service conditions and reduced wood from chemical treatment (including incising). Fasteners and connectors must be compatible with material for and service conditions for adequate corrosion resistance.

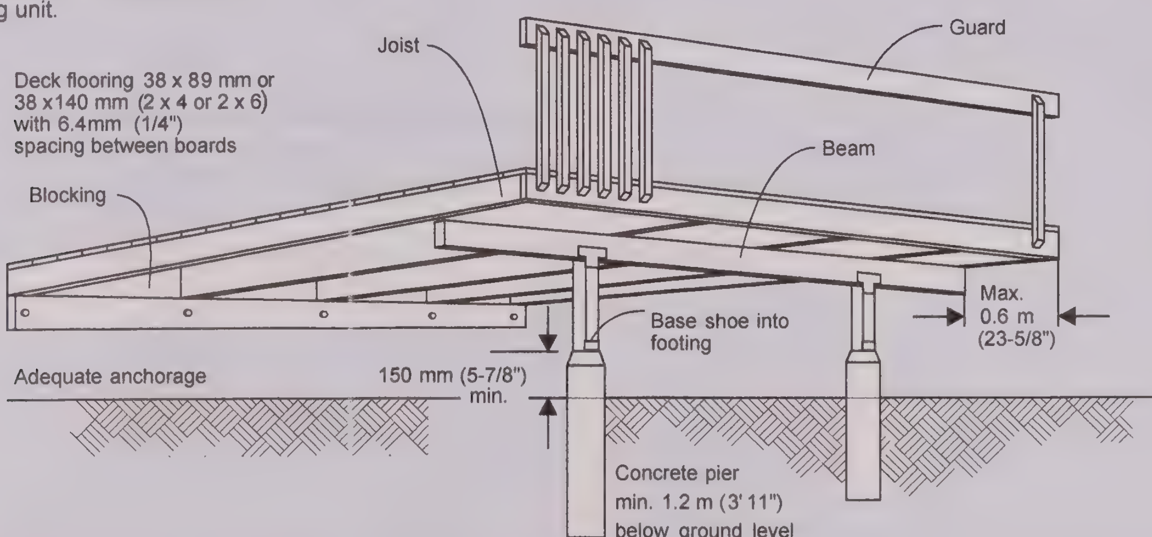
Most Common Inspection Deficiencies:

- Notching of railing posts.
- Use of improper, split or under-sized pickets in guards.
- Splicing of beams not over supports.
- Use of unauthorized material or systems.
- Unauthorized changes from permit drawings.

Not all products or materials sold are approved for use in Ontario. Applications proposing materials not listed in the Code may require submission of the manufacturer's installation manual, engineering data, or BMEC or CCMC approval. Prior to starting construction, a permit may be required. Please consult your local municipality for detailed requirements.



Wall Anchorage Detail for Deck - Foundation Wall



Building Code for Housing

Table of Contents

Supplementary Standards

Commencement
Ontario Regulation 332/12 comes into force on the 1st day of January, 2014

Part 1
Compliance and General

Section 1.1. Organization and Application

1.1.1. Organization of this Code

1.1.1.1. Scope of Division A

(1) Division A contains compliance and application provisions and the *objectives* and *functional statements* of this Code.

1.1.1.2. Scope of Division B

(1) Division B contains the *acceptable solutions* of this Code.

1.1.1.3. Scope of Division C

(1) Division C contains the administrative provisions of this Code.

1.1.1.4. Internal Cross-References

(1) If a provision of this Code contains a reference to another provision of this Code but no Division is specified, both provisions are in the same Division of this Code.

1.1.2. Application of Division B (See Appendix A.)

1.1.2.1. Application of Parts 1, 7 and 12

(1) Parts 1, 7 and 12 of Division B apply to all *buildings*.

1.1.2.4. Application of Part 9

(1) Subject to Articles 1.1.2.6. and 1.3.1.2., Part 9 of Division B applies to all *buildings*,
(a) of three or fewer *storeys* in *building height*,
(b) having a *building area* not exceeding 600 m², and
(c) used for *major occupancies* classified as,
  (i) Group C, *residential occupancies*

1.1.3. Building Size Determination

1.1.3.1. Building Size Determination of Building Divided by Firewalls (See Appendix A.)

(1) Where a *firewall* divides a *building*, each portion of the *building* that is divided shall be considered as a separate *building*, except for the purposes of,
(a) a determination of *gross area* in Section 1.2. of Division C,
(b) a fire alarm and detection system in Sentence 3.2.4.2.(1) of Division B or Article 9.10.18.1. of Division B, and
(c) a *plumbing system* interconnected through a *firewall*.

1.1.3.2. Building Size Determination of Building Divided by Vertical Fire Separations

(1) Except as permitted in Sentence (2), if portions of a *building* are completely separated by a vertical *fire separation* that has a *fire-resistance rating* of at least 1 h and that extends through all *storeys* and *service spaces* of the separate portions, each separated portion may be considered to be a separate *building* for the purpose of determining *building height* if,
(a) each separated portion is not more than three *storeys* in *building height* and is used only for *residential occupancies*, and
(b) the unobstructed path of travel for a firefighter from the nearest *street* to one entrance to each separated portion is not more than 45 m.

(2) The vertical *fire separation* in Sentence (1) may terminate at the floor assembly immediately above a *basement* if the *basement* conforms to Article 3.2.1.2. of Division B.

Section 1.2. Compliance

1.2.1. Compliance With Division B

1.2.1.1. Compliance With Division B

(1) Compliance with Division B shall be achieved,
(a) by complying with the applicable *acceptable solutions* in Division B, or (See Appendix A.)
(b) by using *alternative solutions* that will achieve the level of performance required by the applicable *acceptable solutions* in respect of the *objectives* and *functional statements* attributed to the applicable *acceptable solutions* in MMAH Supplementary Standard SA-1, "Objectives and Functional Statements Attributed to the Acceptable Solutions". (See Appendix A.)

(2) For the purposes of Clause (1)(b), the level of performance in respect of a *functional statement* refers to the performance of the *functional statement* as it relates to the *objective* with which it is associated in MMAH Supplementary Standard SA-1, "Objectives and Functional Statements Attributed to the Acceptable Solutions".

1.2.2. Materials, Appliances, Systems and Equipment

1.2.2.1. Characteristics of Materials, Appliances, Systems and Equipment

(1) All materials, *appliances*, systems and equipment installed to meet the requirements of this Code shall possess the necessary characteristics to perform their intended functions when installed in a *building*.

1.2.2.2. Used Materials, Appliances and Equipment

(1) Unless otherwise specified, recycled materials in *building* products may be used and used materials, *appliances* and equipment may be reused when they meet the requirements of this Code for new materials and are satisfactory for their intended use.

Section 1.3. Interpretation

1.3.1. Interpretation

1.3.1.1. Designated Structures

(1) The following structures are designated for the purposes of clause (d) of the definition of *building* in subsection 1(1) of the Act:
(f) a solar collector that is mounted on a *building* and has a face area equal to or greater than 5 m^2, and
(h) a dish antenna that is mounted on a *building* and has a face area equal to or greater than 5 m^2

Section 1.4. Terms and Abbreviations

1.4.1. Definitions of Words and Phrases

1.4.1.1. Non-defined Terms

(1) Definitions of words and phrases used in this Code that are not included in the list of definitions in Articles 1.4.1.2., 1.4.1.3. and 1.4.1.4. and are not defined in another provision of this Code shall have the meanings that are commonly assigned to them in the context in which they are used, taking into account the specialized use of terms by the various trades and professions to which the terminology applies.

1.4.1.2. Defined Terms

(1) Each of the words and terms in italics in this Code has,
(a) the same meaning as in subsection 1(1) of the Act, if not defined in Clause (b) or (c),
(b) the same meaning as in each of the following provisions for the purposes described in the provision:
  (i) Sentences 1.4.1.3.(1) and (2) of Division A, and
  (ii) Sentences 3.13.1.2.(1), 7.1.3.1.(1), 8.1.1.2.(1) and 11.1.1.2.(1) of Division B, or
(c) the following meaning for the purposes of this Code:

Acceptable solution means a requirement stated in Parts 3 to 12 of Division B.

Air barrier system means an assembly installed to provide a continuous barrier to the movement of air.

Air-conditioning is the process of treating air in a space to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the comfort requirements of the occupants of the space.

Allowable bearing pressure means the maximum pressure that may be safely applied to a *soil* or *rock* by the *foundation unit* considered in design under expected loading and subsurface conditions.

Allowable load means the maximum load that may be safely applied to a *foundation unit* considered in design under expected loading and subsurface conditions.

Alternative solution means a substitute for an *acceptable solution*.

Appliance means a device to convert fuel into energy and includes all components, controls, wiring and piping required to be part of the device by the applicable standard referred to in this Code.

Architect means the holder of a licence, a certificate of practice or a temporary licence under the *Architects Act*.

As constructed plans means *construction* plans and specifications that show the *building* and the location of the *building* on the property as the *building* has been constructed.

Attic or roof space means the space between the roof and the ceiling of the top *storey* or between a dwarf wall and a sloping roof.

Basement means one or more *storeys* of a *building* located below the *first storey*.

Bearing surface means the contact surface between a *foundation unit* and the *soil* or *rock* on which the *foundation unit* bears.

Boiler means an *appliance* intended to supply hot water or steam for space heating, processing or power purposes.

Breeching means a *flue pipe* or chamber for receiving *flue* gases from one or more *flue* connections and for discharging these gases through a single *flue* connection.

Building area means the greatest horizontal area of a *building* above *grade*,
- (a) within the outside surface of exterior walls, or
- (b) within the outside surface of exterior walls and the centre line of *firewalls*.

Building Code website means the website at www.ontario.ca/buildingcode.

Building height means the number of *storeys* contained between the roof and the floor of the *first storey*.

Chimney means a shaft that is primarily vertical and that encloses at least one *flue* for conducting *flue* gases to the outdoors.

Chimney liner means a conduit containing a *chimney flue* used as a lining of a *masonry or concrete chimney*.

Closure means a device or assembly for closing an opening through a *fire separation* or an exterior wall, such as a door, a shutter, wired glass and glass block, and includes all components such as hardware, closing devices, frames and anchors.

Combustible means that a material fails to meet the acceptance criteria of CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials".

Combustible construction means a type of construction that does not meet the requirements for *noncombustible construction*.

Cooktop means a cooking surface having one or more burners or heating elements.

Dead load means the weight of all permanent structural and nonstructural components of a *building*.

Deep foundation means a *foundation unit* that provides support for a *building* by transferring loads either by end-bearing to a *soil* or *rock* at considerable depth below the *building* or by adhesion or friction, or both, in the *soil* or *rock* in which it is placed. *Piles* are the most common type of *deep foundation*.

Design activities means the activities described in subsection 15.11(5) of the Act.

Designer means the person responsible for the design.

Design load means the load applied to a *foundation unit*, which load is not greater than the *allowable load*.

Dwelling unit means a *suite* operated as a housekeeping unit, used or intended to be used by one or more persons and usually containing cooking, eating, living, sleeping and sanitary facilities.

Electric space heating means an electric energy source that provides more than 10 per cent of the heating capacity provided for a *building* and includes,
- (a) electric resistance unitary baseboard heating,
- (b) electric resistance unitary cabinet heating,
- (c) electric resistance ceiling cable or floor cable heating,
- (d) electric resistance central furnace heating,
- (e) electric hot water space heating, and
- (f) air source heat pumps in combination with electric resistance backup heating.

Excavation means the space created by the removal of *soil*, *rock* or *fill* for the purposes of construction.

Exhaust duct means a duct through which air is conveyed from a room or space to the outdoors.

Exit means that part of a *means of egress*, including doorways, that leads from the *floor area* it serves to a separate *building*, an open public thoroughfare or an exterior open space protected from fire exposure from the *building* and having access to an open public thoroughfare. (See Appendix A.)

Exposing building face means that part of the exterior wall of a *building* that faces one direction and is located between ground level and the ceiling of its top *storey* or, where the *building* is divided into *fire compartments*, the exterior wall of a *fire compartment* that faces one direction.

Exterior cladding means those components of a *building* that are exposed to the outdoor environment and are intended to provide protection against wind, water or vapour.

Factory-built chimney means a *chimney* consisting entirely of factory-made parts, each designed to be assembled with the other without requiring fabrication on site.

Fill means *soil*, *rock*, rubble, industrial waste such as slag, organic material or a combination of these that is transported and placed on the natural surface of a *soil* or *rock* or organic terrain; it may or may not be compacted.

Fire block means a material, component or system that restricts the spread of fire within a concealed space or from a concealed space to an adjacent space.

Fire compartment means an enclosed space in a *building*,
(a) that is separated from all other parts of the *building* by enclosing construction that provides a *fire separation*, and
(b) that may be required to have a *fire-resistance rating*.

Fire-protection rating means the time in minutes or hours that a *closure* will withstand the passage of flame when exposed to fire under specified conditions of test and performance criteria, or as otherwise prescribed in this Code.

Fire-resistance rating means the time in minutes or hours that a material or assembly of materials will withstand the passage of flame and the transmission of heat when exposed to fire under specified conditions of test and performance criteria, or as determined by extension or interpretation of information derived from that test and performance as prescribed in this Code.

Fire separation means a construction assembly that acts as a barrier against the spread of fire. (See Appendix A.)

Fire stop means a system consisting of a material, component and means of support, used to fill gaps between *fire separations* or between *fire separations* and other assemblies, or used around items that wholly or partially penetrate a *fire separation*.

Firewall means a type of *fire separation* of *noncombustible construction* that subdivides a *building* or separates adjoining *buildings* to resist the spread of fire and that has a *fire-resistance rating* as prescribed in this Code and the structural stability to remain intact under fire conditions for the required fire-rated time.

First storey means the *storey* that has its floor closest to *grade* and its ceiling more than 1.8 m above *grade*.

Fixture means a receptacle, *plumbing appliance*, apparatus or other device that discharges *sewage* or *clear water waste*, and includes a floor drain.

Flame-spread rating means an index or classification indicating the extent of the spread of flame on the surface of a material or an assembly of materials, as determined in a standard fire test prescribed in this Code.

Floor area means the space on any *storey* of a *building* between exterior walls and required *firewalls*, including the space occupied by interior walls and *partitions*, but not including *exits*, *vertical service spaces* and their enclosing assemblies.

Flue means an enclosed passageway for conveying *flue* gases.

Flue collar means the portion of a fuel-fired *appliance* designed for the attachment of the *flue pipe* or *breeching*.

Flue pipe means the pipe connecting the *flue collar* of an *appliance* to a *chimney*.

Forced-air furnace means a *furnace* equipped with a fan that provides the primary means for the circulation of air.

Foundation means a system or arrangement of *foundation units* through which the loads from a *building* are transferred to supporting *soil* or *rock*.

Foundation unit means one of the structural members of the *foundation* of a *building*, such as a footing, raft and *pile*.

Functional statement means a function set out in Table 3.2.1.1. that a *building* or an element of a *building* is intended to perform.

Furnace means a *space-heating appliance* that uses warm air as the heating medium and usually provides for the attachment of ducts.

Gas vent means that portion of a venting system designed to convey vent gases to the outdoors,
(a) from the *vent connector* of a gas-fired *appliance*, or
(b) directly from the *appliance* when a *vent connector* is not used.

Grade means the average level of proposed or finished ground adjoining a *building* at all exterior walls.

Graded lumber means lumber that has been graded and stamped to indicate its grade, as determined by the NLGA, "Standard Grading Rules for Canadian Lumber".

Gross area means the total area of all floors above *grade* measured between the outside surfaces of exterior walls or between the outside surfaces of exterior walls and the centre line of *firewalls*, except that, in any *occupancy* other than a *residential occupancy*, where an access or a *building* service penetrates a *firewall*, measurements shall not be taken to the centre line of such *firewall*.

Groundwater means a free standing body of water in the ground.

Groundwater level means the top surface of *groundwater*.

Guard means a protective barrier, with or without openings through it, that is around openings in floors or at the open sides of stairs, landings, balconies, *mezzanines*, galleries, raised *walkways* or other locations to prevent accidental falls from one level to another.

Horizontal service space means a space such as an attic, duct, ceiling, roof or crawl space,
(a) that is oriented essentially in a horizontal plane,
(b) that is concealed and generally inaccessible, and
(c) through which *building* service facilities such as pipes, ducts and wiring may pass.

Limiting distance means the distance from an *exposing building face* to a property line, to the centre line of a *street*, lane or public thoroughfare or to an imaginary line between two *buildings* or *fire compartments* on the same property, measured at right angles to the *exposing building face*.

Listed means equipment or materials included in a list published by a certification organization accredited by the Standards Council of Canada.

Live load means a variable load due to the intended use and *occupancy* that is to be assumed in the design of the structural members of a *building* and includes loads due to cranes and the pressure of liquids in containers.

Major occupancy means the principal *occupancy* for which a *building* or part of a *building* is used or intended to be used, and is deemed to include the subsidiary *occupancies* that are an integral part of the principal *occupancy*. The *major occupancy* classifications used in this Code are as follows:
(h) Group C - *Residential occupancies*,

Masonry or concrete chimney means a *chimney* of brick, stone, concrete or masonry units constructed on site.

Means of egress includes *exits* and *access to exits* and means a continuous path of travel provided for the escape of persons from any point in a *building* or in a contained open space to,
(a) a separate *building*,
(b) an open public thoroughfare, or
(c) an exterior open space that is protected from fire exposure from the *building* and that has access to an open public thoroughfare.

Mezzanine means an intermediate floor assembly between the floor and ceiling of any room or *storey* and includes an interior balcony.

Noncombustible means that a material meets the acceptance criteria of CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials".

Noncombustible construction means a type of construction in which a degree of fire safety is attained by the use of *noncombustible* materials for structural members and other building assemblies.

Objective means an objective set out in Article 2.2.1.1.

Occupancy means the use or intended use of a *building* or part of a *building* for the shelter or support of persons, animals or property.

Occupant load means the number of persons for which a *building* or part of a *building* is designed.

Partition means an interior wall, one *storey* or part-*storey* in height, that is not *loadbearing*.

Party wall means a wall,
(a) that is jointly owned and jointly used by two parties under an easement agreement or by a right in law, and
(b) that is erected at or upon a line separating two parcels of land each of which is, or is capable of being, a separate real estate entity.

Plenum means a chamber forming part of an air duct system.

Plumbing system means a system of connected piping, fittings, valves, equipment, *fixtures* and appurtenances contained in *plumbing*. (See Appendix A.)

Point of entry treatment unit has the same meaning as in subsection 1(1) of Ontario Regulation 170/03 (Drinking Water Systems) made under the *Safe Drinking Water Act, 2002*.

Potable means fit for human consumption.

Potable water system means the *plumbing* that conveys *potable* water.

Private sewage disposal system means a *sewage system* or a *sewage works* that is not owned and operated by the Crown, a municipality or an organization acceptable to the Director responsible for issuing an environmental compliance approval required under section 53 of the *Ontario Water Resources Act*.

Professional engineer means a person who holds a licence or a temporary licence under the *Professional Engineers Act*.

Residential occupancy means an *occupancy* in which sleeping accommodation is provided to residents who are not harboured for the purpose of receiving special care or treatment and are not involuntarily detained.

Return duct means a duct for conveying air from a space being heated, ventilated or air-conditioned back to the heating, ventilating or *air-conditioning appliance*.

Rock means a portion of the earth's crust that is consolidated, coherent and relatively hard and that is a naturally formed, solidly bonded, mass of mineral matter that cannot readily be broken by hand.

Service space means space provided in a *building* to facilitate or conceal the installation of building service facilities such as chutes, ducts, pipes, shafts or wires.

Service water heater means a device for heating water for *plumbing* services.

Shallow foundation means a *foundation unit* that derives its support from *soil* or *rock* located close to the lowest part of the *building* that it supports.

Smoke alarm means a combined *smoke detector* and audible alarm device designed to sound an alarm within the room or *suite* in which it is located on the detection of smoke within that room or *suite*.

Smoke detector means a *fire detector* designed to operate when the concentration of airborne combustion products exceeds a pre-determined level.

Soil means, except for the purposes of Part 8 of Division B, a portion of the earth's crust that is fragmentary or such that individual particles of a dried sample may be readily separated by agitation in water, and includes boulders, cobbles, gravel, sand, silt, clay and organic matter.

Space heater means a *space-heating appliance* for heating the room or space within which it is located, without the use of ducts.

Space-heating appliance means an *appliance*,
- (a) that is intended to supply heat directly to a room or space, such as a *space heater*, fireplace and *unit heater*, or
- (b) that is intended to supply heat to rooms or spaces of a *building* through a heating system, such as a central *furnace* or *boiler*.

Sprinklered means equipped with a system of automatic sprinklers.

Storage garage means a *building* or part of a *building* that is intended for the storage or parking of motor vehicles and that contains no provision for the repair or servicing of motor vehicles.

Storage-type service water heater means a *service water heater* with an integral hot water storage tank.

Storey means, except for the purposes of Part 7 of Division B, the portion of a *building*,
- (a) that is situated between the top of any floor and the top of the floor next above it, or
- (b) that is situated between the top of the floor and the ceiling above the floor, if there is no floor above it.

Stove means an *appliance* intended for cooking or space heating or both.

Street means any highway, road, boulevard, square or other improved thoroughfare that is 9 m or more in width, that has been dedicated or deeded for public use and that is accessible to fire department vehicles and equipment.

Subsurface investigation means the appraisal of the general subsurface conditions at a *building* site by analysis of information gained by methods such as geological surveys, in situ testing, sampling, visual inspection, laboratory testing of samples of the subsurface materials and *groundwater* observations and measurements.

Suite means a single room or series of rooms of complementary use, operated under a single tenancy, and includes,
(a) *dwelling unit*

Supply duct means a duct for conveying air from a heating, ventilating or *air-conditioning appliance* to a space to be heated, ventilated or air-conditioned.

Tarion Warranty Corporation means Tarion Warranty Corporation as designated under section 2 of the *Ontario New Home Warranties Plan Act*.

Unit heater means a suspended *space heater* with an integral air circulating fan.

Unprotected opening means, when applied to an *exposing building face*,
(a) a doorway, window or opening, other than one equipped with a closure having the required *fire-protection rating*, or
(b) any part of a wall forming part of the *exposing building face* that has a *fire-resistance rating* less than required for the *exposing building face*.

Vapour barrier means the elements installed to control the diffusion of water vapour.

Vent connector means, when applied to a heating or cooling system, the part of a venting system that conducts the *flue* gases or vent gases from the *flue collar* of a gas *appliance* to the *chimney* or *gas vent*, and may include a draft control device.

Water distribution system means an assembly of pipes, fittings, valves and appurtenances that conveys *potable water* to water supply outlets, *fixtures*, *plumbing appliances* and devices from the *water service pipe* or from a *point of entry treatment unit* located in the *building*.

Water service pipe means a pipe on the property that conveys *potable* water from a *drinking water system* or a *private water supply* to the inside of the *building*.

Water system means a *water service pipe*, a *private water supply*, a *water distribution system*, a *fire service main* or any part of any of them.

1.4.1.3. Definition of Applicable Law (See Appendix A.)

(1) For the purposes of clause 8(2)(a) of the Act, *applicable law* means,
(a) the statutory requirements in the following provisions with respect to the following matters:
- (i) section 114 of the *City of Toronto Act, 2006* with respect to the approval by the City of Toronto or the Ontario Municipal Board of plans and drawings,
- (vi) section 5 of the *Environmental Assessment Act* with respect to the approval of the Minister or the Environmental Review Tribunal to proceed with an undertaking,
- (vii) section 46 of the *Environmental Protection Act* with respect to the approval of the Minister to use land or land covered by water that has been used for the disposal of waste,
- (viii) section 47.3 of the *Environmental Protection Act* with respect to the issuance of a renewable energy approval,
- (ix) section 168.3.1 of the *Environmental Protection Act* with respect to the *construction* of a *building* to be used in connection with a change of use of a property,
- (x) paragraph 2 of subsection 168.6(1) of the *Environmental Protection Act* if a certificate of property use has been issued in respect of the property under subsection 168.6(1) of that Act,
- (xix) section 14 of the *Ontario Planning and Development Act, 1994* with respect to any conflict between a development plan made under that Act and a zoning by-law that affects the proposed *building* or structure,
- (xx) section 41 of the *Planning Act* with respect to the approval by the council of the *municipality* or the Ontario Municipal Board of plans and drawings,
- (xxi) section 42 of the *Planning Act* with respect to the payment of money or making arrangements satisfactory to the council of a *municipality* for the payment of money, where the payment is required under subsection 42(6) of that Act,
- (xxiii) section 34 or 38 of the *Public Transportation and Highway Improvement Act* with respect to the permit from the Minister for the placement, erection or alteration of any *building* or other structure or the use of land,

(b) the following provisions of Acts and regulations:
  (i) subsection 102(3) of the *City of Toronto Act, 2006*,
  (ii) sections 28 and 53 of the *Development Charges Act, 1997*,
  (iii) sections 257.83 and 257.93 of the *Education Act*,
  (iv) subsection 5(4) of the *Environmental Assessment Act*,
  (v) subsection 133(4) of the *Municipal Act, 2001*,
  (vi) subsection 24(3) of the *Niagara Escarpment Planning and Development Act*,
  (viii) section 33 of the *Planning Act* except where, in the case of the *demolition* of a residential property, a permit to *demolish* the property is obtained under that section,
  (ix) section 46 of the *Planning Act*,

(c) regulations made by a conservation authority under clause 28(1)(c) of the *Conservation Authorities Act* with respect to permission of the authority for the *construction* of a *building* or structure if, in the opinion of the authority, the control of flooding, erosion, dynamic beaches or pollution or the conservation of land may be affected by the development,

(d) by-laws made under section 108 of the *City of Toronto Act, 2006*, but only with respect to the issuance of a permit for the *construction* of a green roof if the *construction* of the roof is prohibited unless a permit is obtained,

(f) by-laws made under section 34 or 38 of the *Planning Act*,

(g) subject to clause (h), by-laws made under Ontario Regulation 608/06 (Development Permits) made under the *Planning Act*,

(h) by-laws referred to in clause (g) in relation to the development of land, but only with respect to the issuance of a development permit if the development of land is prohibited unless a development permit is obtained,

(i) by-laws made under Ontario Regulation 246/01 (Development Permits) made under the *Planning Act* which continue in force despite the revocation of that Regulation by reason of section 17 of Ontario Regulation 608/06 (Development Permits) made under that Act,

(j) orders made by the Minister under section 47 of the *Planning Act* or subsection 17(1) of the *Ontario Planning and Development Act, 1994*, and

(k) by-laws made under any private Act that prohibit the proposed *construction* or *demolition* of the *building* unless the by-law is complied with.

(2) For the purposes of clause 10(2)(a) of the Act, *applicable law* means any general or special Act, and all regulations and by-laws enacted under them that prohibit the proposed use of the *building* unless the Act, regulation or by-law is complied with.

1.4.1.4. Other Definitions for the Purposes of the Act

(1) For the purposes of the Act, *architect*, *as constructed plans* and *professional engineer* have the same meaning as that set out in Clause 1.4.1.2.(1)(c).

1.4.2. Symbols and Other Abbreviations

1.4.2.1. Symbols and Other Abbreviations

(1) In this Code, a symbol or abbreviation listed in Column 1 of Table 1.4.2.1. has the meaning listed opposite it in Column 2.

Table 1.4.2.1.
Symbols and Abbreviations
Forming Part of Sentence 1.4.2.1.(1)

Symbol or Abbreviation	Meaning
1 in 2	slope of 1 vertical to 2 horizontal
ASWG	American Steel Wire Gage
ABS	acrylonitrile-butadiene-styrene
Bq	becquerel(s)
$CBOD_5$	the five day carbonaceous biochemical oxygen demand
CO_2e	carbon dioxide equivalent
CFU	colony forming units
cm	centimetre(s)
cm^2	square centimetre(s)
CPVC	chlorinated poly (vinyl chloride)
dB(A)	A-weighted sound level
°	degree(s)
°C	Degree(s) Celsius
diam	diameter
DWV	drain, waste and vent
ft	foot (feet)
g	gram(s)
ga	gauge
gal	imperial gallon(s)
gal/min	imperial gallon(s) per minute
h	hour(s)
HVAC	heating, ventilating and air-conditioning
Hz	hertz
in.	inch(es)
J	joule(s)
kg	kilogram(s)
kg/m^2	kilograms per square metre
kN	kilonewton(s)
kPa	kilopascal(s)
kW	kilowatt(s)
L	litre(s)
L/min	litre(s) per minute
L/s	litre(s) per second
LPF	litres per flush
lx	lux
m	metre(s)
m^2	square metre(s)
m^3	cubic metre(s)
m/s	metre(s) per second
max.	maximum
Column 1	2

Table 1.4.2.1. (Cont'd)
Symbols and Abbreviations
Forming Part of Sentence 1.4.2.1.(1)

Symbol or Abbreviation	Meaning
mg/L	milligram(s) per litre
min	minute(s)
min.	minimum
MJ	megajoule(s)
mm	millimetre(s)
MPa	megapascal(s)
N	newton
N/A	not applicable
ng	nanogram(s)
No.	number(s)
nom.	nominal
o.c.	on centre
OSB	oriented strandboard
Pa	pascal(s)
PB	polybutylene
PE	polyethylene
PE/AL/PE	polyethylene/aluminum/polyethylene
PEX	crosslinked polyethylene
PEX/AL/PEX	crosslinked polyethylene/aluminum/crosslinked polyethylene
PVC	poly (vinyl chloride)
RSI	thermal resistance, International System of Units
s	second(s)
temp.	temperature
T&G	tongue and groove
W	watt(s)
wt	weight
%	percent
µg	microgram(s)
µm	micron
Column 1	2

Section 1.5. Referenced Documents and Organizations

1.5.1. Referenced Documents

1.5.1.1. Application of Referenced Documents

(1) The provisions of a referenced document in Divisions A and B apply only to the extent that the provisions relate to,
(a) *buildings*, and
(b) the *objectives* and *functional statements* attributed to the applicable *acceptable solutions* in Division B where the document is referenced.
(See Appendix A.)

1.5.1.2. Conflicting Requirements

(1) In the case of a conflict between the provisions of this Code and those of a referenced document, the provisions of this Code shall govern.

1.5.1.3. Applicable Editions

(1) Where documents are referenced in this Code, they shall be the editions designated in Subsection 1.3.1. of Division B.

1.5.2. Organizations

1.5.2.1. Abbreviations of Proper Names

(1) The abbreviations of proper names in this Code shall have the meanings assigned to them in Article 1.3.2.1. of Division B.

Part 1

General

Section 1.1. General

1.1.1. Application

1.1.1.1. Application

(1) This Part applies to all *buildings* covered in this Code.

1.1.2. Climatic Data

1.1.2.1. Climatic and Seismic Design Values

(1) The climatic and seismic values required for the design of *buildings* under this Code shall be in conformance with the climatic and seismic values provided in MMAH Supplementary Standard SB-1, "Climatic and Seismic Data".

(2) The outside winter design temperatures determined from MMAH Supplementary Standard SB-1, "Climatic and Seismic Data", shall be those listed for the January 2.5% values. (See Appendix A.)

1.1.2.2. Depth of Frost Penetration

(1) Depth of frost penetration shall be established on the basis of local experience.

Section 1.2. Reserved

Section 1.3. Referenced Documents and Organizations

1.3.1. Referenced Documents

1.3.1.1. Effective Date

(1) Unless otherwise specified in this Code, the documents referenced in this Code shall include all amendments, revisions and supplements effective to May 1, 2012.

1.3.1.2. Applicable Editions

(1) Where documents are referenced in this Code, they shall be in the editions designated in Column 2 of Table 1.3.1.2.

Table 1.3.1.2.
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
AISI	S201-07	North American Standard for Cold Formed Steel Framing – Product Data	9.24.1.2.(1)
ANSI	A208.1-2009	Particleboard	9.23.14.2.(3) 9.29.9.1.(1) 9.30.2.2.(1)
ANSI/ASHRAE	62.1-2010	Ventilation for Acceptable Indoor Air Quality	6.2.2.1.(2) 6.2.3.8.(15)
ASHRAE	2009	Fundamentals	5.2.1.3.(1) 6.2.1.1.(1)
ASHRAE	2011	HVAC Applications	6.2.1.1.(1)
ASHRAE	2012	HVAC Systems and Equipment	6.2.1.1.(1)
ASHRAE	2010	Refrigeration	6.2.1.1.(1)
ASME	B18.6.1-1981	Wood Screws (Inch Series)	Table 5.10.1.1. 9.23.3.1.(3)
ASTM	A123 / A123M-08	Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products	Table 9.20.16.1.
ASTM	A153 / A153M-05	Zinc Coating (Hot-Dip) on Iron and Steel Hardware	Table 9.20.16.1.
ASTM	A653 / A653M-08	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process	9.3.3.2.(1)
ASTM	A792 / A792M-08	Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process	9.3.3.2.(1)
ASTM	C4-04e1	Clay Drain Tile and Perforated Clay Drain Tile	9.14.3.1.(1)
ASTM	C27-98	Classification for Fire Clay and High-Alumina Refractory Brick	9.21.3.4.(1)
ASTM	C73-05	Calcium Silicate Brick (Sand-Lime Brick)	9.20.2.1.(1)
ASTM	C126-99	Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units	9.20.2.1.(1)
ASTM	C212-00	Structural Clay Facing Tile	9.20.2.1.(1)
ASTM	C260-06	Air-Entraining Admixtures for Concrete	9.3.1.8.(1)
ASTM	C411-05	Hot-Surface Performance of High-Temperature Thermal Insulation	6.2.9.2.(2)
ASTM	C412M-05a	Concrete Drain Tile (Metric)	9.14.3.1.(1)
ASTM	C444M-03	Perforated Concrete Pipe (Metric)	9.14.3.1.(1)
ASTM	C494 / C494M-08	Chemical Admixtures for Concrete	9.3.1.8.(1)
ASTM	C700-07a	Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated	9.14.3.1.(1)
ASTM	C834-05	Latex Sealants	9.27.4.2.(2)
ASTM	C920-05	Elastomeric Joint Sealants	9.27.4.2.(2)
ASTM	C954-07	Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness	9.24.1.4.(1)
ASTM	C1002-07	Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs	9.24.1.4.(1) 9.29.5.7.(1)
ASTM	C1177 / C1177M-08	Glass Mat Gypsum Substrate for Use as Sheathing	Table 9.23.16.2.A.
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
ASTM	C1178 / C1178M-08	Coated Glass Mat Water-Resistant Gypsum Backing Panel	9.29.5.2.(1)
ASTM	C1184-05	Structural Silicone Sealants	9.27.4.2.(2)
ASTM	C1311-02	Solvent Release Sealants	9.27.4.2.(2)
ASTM	C1330-02	Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants	9.27.4.2.(3)
ASTM	C1396 / C1396M-06a	Gypsum Board	Table 9.23.17.2.A. 9.29.5.2.(1) Table 9.29.5.3.
ASTM	E90-04	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements	9.11.1.1.(1)
ASTM	E96 / E96M-05	Water Vapour Transmission of Materials	9.25.4.2.(1) 9.25.5.1.(1); 9.30.1.2.(1)
ASTM	E336-05	Measurement of Airborne Sound Attenuation Between Rooms in Buildings	9.11.1.1.(1)
ASTM	E413-04	Classification for Rating Sound Insulation	9.11.1.1.(1)
ASTM	E2190-08	Insulating Glass Unit Performance and Evaluation	9.6.1.2.(1)
ASTM	F476-84	Security of Swinging Door Assemblies	9.7.5.2.(2)
ASTM	F1167-05	Driven Fasteners: Nails, Spikes and Staples	9.23.3.1.(1) 9.26.2.2.(1) 9.29.5.6.(1)
BNQ	BNQ 3624-115-2007	Polyethylene (PE) Pipe and Fittings - Flexible Pipes for Drainage - Characteristics and Test Methods	9.14.3.1.(1)
CCBFC	NRCC 53301 2010	National Building Code of Canada	2.4.2.1.(2) of Division C
CCBFC	NRCC 53302 2010	National Plumbing Code of Canada	2.4.2.1.(2) of Division C
CGSB	CAN/CGSB-1.501-M89	Method of Permeance of Coated Wallboard	9.25.4.2.(5)
CGSB	CAN/CGSB-7.2-94	Adjustable Steel Columns	9.17.3.4.(1)
CGSB	CAN/CGSB-10.3-92	Air Setting Refractory Mortar	9.21.3.4.(2) 9.21.3.9.(1) 9.22.2.2.(2)
CGSB	CAN/CGSB-11.3-M87	Hardboard	9.27.9.1.(2) 9.29.7.1.(1) 9.30.2.2.(1)
CGSB	CAN/CGSB-11.5-M87	Hardboard, Precoated, Factory Finished, for Exterior Cladding	9.27.9.1.(1)
CGSB	CAN/CGSB-12.1-M90	Tempered or Laminated Safety Glass	9.6.1.2.(2) 9.6.1.4.(1) 9.8.8.7.(1)
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
CGSB	CAN/CGSB-12.2-M91	Flat, Clear Sheet Glass	9.6.1.2.(1)
CGSB	CAN/CGSB-12.3-M91	Flat, Clear Float Glass	9.6.1.2.(1)
CGSB	CAN/CGSB-12.4-M91	Heat Absorbing Glass	9.6.1.2.(1)
CGSB	CAN/CGSB-12.5-M86	Mirrors, Silvered	9.6.1.2.(3)
CGSB	CAN/CGSB-12.8-97	Insulating Glass Units	9.6.1.2.(1)
CGSB	CAN/CGSB-12.10-M76	Glass, Light and Heat Reflecting	9.6.1.2.(1)
CGSB	CAN/CGSB-12.11-M90	Wired Safety Glass	9.6.1.2.(2) 9.6.1.4.(1) 9.8.8.7.(1)
CGSB	CAN/CGSB-12.20-M89	Structural Design of Glass for Buildings	9.6.1.3.(1)
CGSB	CAN/CGSB-19.22-M89	Mildew Resistant Sealing Compound for Tubs and Tile	9.29.10.5.(1)
CGSB	CAN/CGSB-34.22-94	Asbestos-Cement Drain Pipe	9.14.3.1.(1)
CGSB	CAN/CGSB-37.1-M89	Chemical Emulsified Type, Emulsified Asphalt for Dampproofing	9.13.2.2.(1)
CGSB	CAN/CGSB-37.2-M88	Emulsified Asphalt, Mineral Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings	9.13.2.2.(1) 9.13.3.2.(1)
CGSB	CAN/CGSB-37.3-M89	Application of Emulsified Asphalts for Dampproofing or Waterproofing	9.13.2.3.(1) 9.13.3.3.(1)
CGSB	CAN/CGSB-37.4-M89	Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing	9.26.2.1.(1)
CGSB	CAN/CGSB-37.5-M89	Cutback Asphalt Plastic Cement	9.26.2.1.(1)
CGSB	37-GP-6Ma-1983	Asphalt, Cutback, Unfilled, for Dampproofing	9.13.2.2.(1)
CGSB	CAN/CGSB-37.8-M88	Asphalt, Cutback, Filled, for Roof Coating	9.26.2.1.(1)
CGSB	37-GP-9Ma-1983	Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing	9.26.2.1.(1)
CGSB	37-GP-12Ma-1984	Application of Unfilled Cutback Asphalt for Dampproofing	9.13.2.3.(1)
CGSB	CAN/CGSB-37.16-M89	Filled, Cutback Asphalt for Dampproofing and Waterproofing	9.13.2.2.(1) 9.13.3.2.(1)
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
CGSB	37-GP-18Ma-1985	Tar, Cutback, Unfilled, for Dampproofing	9.13.2.2.(1)
CGSB	37-GP-21M-1985	Tar, Cutback, Fibrated, For Roof Coating	9.26.2.1.(1)
CGSB	CAN/CGSB-37.22-M89	Application of Unfilled, Cutback Tar Foundation Coating for Dampproofing	9.13.2.3.(1)
CGSB	CAN/CGSB-37.50-M89	Hot Applied, Rubberized Asphalt for Roofing and Waterproofing	9.26.2.1.(1)
CGSB	CAN/CGSB-37.51-M90	Application for Hot Applied Rubberized Asphalt for Roofing and Waterproofing	9.26.15.1.(1)
CGSB	37-GP-52M-1984	Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric	9.26.2.1.(1)
CGSB	CAN/CGSB-37.54-95	Polyvinyl Chloride Roofing and Waterproofing Membrane	9.26.2.1.(1)
CGSB	37-GP-55M-1979	Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane	9.26.16.1.(1)
CGSB	37-GP-56M-1985	Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing	9.13.2.2.(1) 9.13.3.2.(1) 9.26.2.1.(1)
CGSB	41-GP-6M-1983	Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced	9.26.2.1.(1)
CGSB	CAN/CGSB-41.24-95	Rigid Vinyl Siding, Soffits and Fascia	9.27.12.1.(1)
CGSB	CAN/CGSB-51.25-M87	Thermal Insulation, Phenolic, Faced	Table 9.23.16.2.A. 9.25.2.2.(1)
CGSB	51-GP-27M-1979	Thermal Insulation, Polystyrene, Loose Fill	9.25.2.2.(1)
CGSB	CAN/CGSB-51.32-M77	Sheathing, Membrane, Breather Type	9.20.13.9.(1) 9.26.2.1.(1) 9.27.3.2.(1)
CGSB	CAN/CGSB-51.33-M89	Vapour Barrier, Sheet, Excluding Polyethylene, for Use in Building Construction	9.25.4.2.(4)
CGSB	CAN/CGSB-51.34-M86 (amended 1988)	Vapour Barrier, Polyethylene Sheet for Use in Building Construction	9.13.2.2.(1) 9.13.4.2.(1) 9.18.6.2.(1) 9.25.3.2.(2) 9.25.3.6.(1) 9.25.4.2.(3)
CGSB	CAN/CGSB-82.6-M86	Doors, Mirrored Glass, Sliding or Folding, Wardrobe	9.6.1.2.(2)
CGSB	CAN/CGSB-93.1-M85	Sheet, Aluminum Alloy, Prefinished Residential	9.27.11.1.(4)
CGSB	CAN/CGSB-93.2-M91	Prefinished Aluminum Siding, Soffits and Facsia for Residential Use	9.10.14.5.(8) 9.10.14.5.(11) 9.10.15.5.(7) 9.10.15.5.(10) 9.27.11.1.(3)
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
CGSB	CAN/CGSB-93.3-M91	Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use	9.27.11.1.(2)
CGSB	CAN/CGSB-93.4-92	Galvanized Steel and Aluminum-Zinc Alloy Coated Steel Siding, Soffits and Fascia, Prefinished, Residential	9.27.11.1.(1)
CSA	CAN/CSA-6.19-01	Residential Carbon Monoxide Alarming Devices	9.33.4.3.(1)
CSA	A23.1-09	Concrete Materials and Methods of Concrete Construction	9.3.1.1.(1) 9.3.1.1.(4) 9.3.1.3.(1) 9.3.1.4.(1) 9.39.1.4.(1)
CSA	CAN/CSA-A82.1-M87	Burned Clay Brick (Solid Masonry Units Made From Clay or Shale)	9.20.2.1.(1)
CSA	A82.4-M1978	Structural Clay Load-Bearing Wall Tile	9.20.2.1.(1)
CSA	A82.5-M1978	Structural Clay Non-Load-Bearing Tile	9.20.2.1.(1)
CSA	CAN3-A82.8-M78	Hollow Clay Brick	9.20.2.1.(1)
CSA	CAN/CSA-A82.27-M91	Gypsum Board	Table 9.23.16.2.A. 9.29.5.2.(1)
CSA	A82.30-M1980	Interior Furring, Lathing and Gypsum Plastering	9.29.4.1.(1)
CSA	A82.31-M1980	Gypsum Board Application	9.10.12.4.(3) 9.29.5.1.(2)
CSA	CAN3-A93-M82	Natural Airflow Ventilators for Buildings	9.19.1.2.(5)
CSA	A123.1-05 / A123.5-05	Asphalt Shingles Made from Organic Felt and Surfaced with Mineral Granules / Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules	9.26.2.1.(1)
CSA	CAN/CSA-A123.2-03	Asphalt Coated Roofing Sheets	9.26.2.1.(1)
CSA	A123.3-05	Asphalt Saturated Organic Roofing Felt	9.26.2.1.(1)
CSA	CAN/CSA-A123.4-04	Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems	9.13.2.2.(1) 9.13.3.2.(1) 9.26.2.1.(1)
CSA	A123.17-05	Asphalt Glass Felt Used in Roofing and Waterproofing	9.26.2.1.(1)
CSA	CAN3-A123.51-M85	Asphalt Shingle Application on Roof Slopes 1:3 and Steeper	9.26.1.2.(1)
CSA	CAN3-A123.52-M85	Asphalt Shingle Application on Roof Slopes 1:6 to Less than 1:3	9.26.1.2.(1)
CSA	CAN/CSA-A165.1-04	Concrete Block Masonry Units	9.15.2.2.(1) 9.17.5.1.(1) 9.20.2.1.(1) 9.20.2.6.(1)
CSA	CAN/CSA-A165.2-04	Concrete Brick Masonry Units	9.20.2.1.(1)
CSA	CAN/CSA-A165.3-04	Prefaced Concrete Masonry Units	9.20.2.1.(1)
CSA	CAN3-A165.4-M85	Autoclaved Cellular Units	9.20.2.1.(1)
CSA	CAN/CSA-A179-04	Mortar and Grout for Unit Masonry	9.15.2.2.(3) 9.20.3.1.(1)
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
CSA	CAN/CSA-A220.0-06	Performance of Concrete Roof Tiles	9.26.2.1.(1)
CSA	CAN/CSA-A220.1-06	Installation of Concrete Roof Tiles	9.26.17.1.(1)
CSA	A277-08	Procedure for Factory Certification of Buildings	9.1.1.9.(1)
CSA	CAN/CSA-A324-M88	Clay Flue Liners	9.21.3.3.(1)
CSA	CAN/CSA-A371-04	Masonry Construction for Buildings	9.15.2.2.(3) 9.20.3.2.(7) 9.20.15.2.(1)
CSA	CAN/CSA-A405-M87	Design and Construction of Masonry Chimneys and Fireplaces	9.21.3.5.(1) 9.22.1.4.(7) 9.22.5.2.(2)
CSA	AAMA/WDMA/CSA 101/I.S.2/A440-08	NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights	Table 9.7.3.3. 9.7.4.1.(1) 9.7.4.2.(1); 9.7.4.3.(2) 9.7.5.1.(1); 9.7.5.3.(1)
CSA	A440.2-09 / A440.3-09	Fenestration Energy Performance / User Guide to CSA A440.2-09, Fenestration Energy Performance	Table 9.7.3.3. 12.3.1.2.(1)
CSA	CAN/CSA-A440.4-07	Window, Door and Skylight Installation	9.7.6.1.(1)
CSA	A440S1-09	Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS -- North American Fenestration Standard/Specification for Windows, Doors, and Skylights	9.7.4.2.(1) 9.7.4.3.(1)
CSA	CAN/CSA-A3001-08	Cementitious Materials for Use in Concrete	9.3.1.2.(1); 9.28.2.1.(1)
CSA	B111-1974	Wire Nails, Spikes and Staples	9.23.3.1.(1) 9.26.2.2.(1) 9.29.5.6.(1)
CSA	CAN/CSA-B182.1-06	Plastic Drain and Sewer Pipe and Pipe Fittings	9.14.3.1.(1)
CSA	CAN/CSA-B214-07	Installation Code for Hydronic Heating Systems	6.2.1.4.(6)
CSA	CAN/CSA-B365-01	Installation Code for Solid-Fuel Burning Appliances and Equipment	6.2.1.4.(1) 6.2.1.4.(5) 9.21.1.3.(2) 9.22.10.2.(1) 9.33.1.2.(1)
CSA	CAN/CSA-B366.1-11	Solid Fuel-Fired Central Heating Appliances	6.2.1.4.(2)
CSA	B415.1-00	Performance Testing of Solid-Fuel-Burning Heating Appliances	6.2.1.4.(7) 9.33.1.2.(2)
CSA	C22.2 No.113-M1984	Fans and Ventilators	9.32.3.9.(6)
CSA	CAN/CSA-C260-M90	Rating for the Performance of Residential Mechanical Ventilating Equipment	9.32.3.9.(1) 9.32.3.9.(2) Table 9.32.3.9.
CSA	CAN/CSA-C439-00	Rating the Performance of Heat/Energy-Recovery Ventilators	6.2.1.6.(2) 9.32.3.11.(2)
CSA	CAN/CSA-C448.2-02	Design and Installation of Earth Energy Systems for Residential and Other Small Buildings	6.2.1.4.(3)
CSA	F280-12	Determining the Required Capacity of Residential Space Heating and Cooling Appliances	6.2.1.1.(1) 9.33.2.2.(3)
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
CSA	CAN/CSA-F326-M91	Residential Mechanical Ventilation Systems	6.2.1.1.(1)
CSA	CAN/CSA-G30.18-M92	Billet Steel Bars for Concrete Reinforcement	9.3.1.1.(4) 9.39.1.3.(1)
CSA	G40.21-04	General Requirements for Rolled or Welded Structural Quality Steel	9.23.4.3.(2)
CSA	CAN/CSA-G401-07	Corrugated Steel Pipe Products	9.14.3.1.(1)
CSA	CAN/CSA-O80.1-08	Specification of Treated Wood	9.3.2.9.(6)
CSA	O115-M1982	Hardwood and Decorative Plywood	9.27.8.1.(1) 9.30.2.2.(1)
CSA	O118.1-08	Western Red Cedar Shakes and Shingles	9.26.2.1.(1) 9.27.7.1.(1)
CSA	O118.2-08	Eastern White Cedar Shingles	9.26.2.1.(1) 9.27.7.1.(1)
CSA	O121-08	Douglas Fir Plywood	9.23.14.2.(1) 9.23.15.2.(1) Table 9.23.16.2.A. 9.27.8.1.(1) 9.30.2.2.(1) Table A-13 Table A-14 Table A-15
CSA	CAN/CSA-O122-06	Structural Glued-Laminated Timber	Table A-11 Table A-16
CSA	CAN/CSA-O132.2 Series-90	Wood Flush Doors	9.7.4.3.(4)
CSA	O141-05	Softwood Lumber	9.3.2.6.(1)
CSA	O151-09	Canadian Softwood Plywood	9.23.14.2.(1) 9.23.15.2.(1) Table 9.23.16.2.A. 9.27.8.1.(1) 9.30.2.2.(1) Table A-13 Table A-14 Table A-15
CSA	O153-M1980	Poplar Plywood	9.23.14.2.(1) 9.23.15.2.(1) Table 9.23.16.2.A. 9.27.8.1.(1) 9.30.2.2.(1)
CSA	O177-06	Qualification Code for Manufacturers of Structural Glued-Laminated Timber	Table A-11 Table A-16
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document(1)	Code Reference
CSA	CAN/CSA-O325.0-07	Construction Sheathing	9.23.14.2.(1) 9.23.14.4.(2) Table 9.23.14.5.B. 9.23.15.2.(1) 9.23.15.3.(2) Table 9.23.15.7.B. Table 9.23.16.2.B. 9.29.9.1.(2) 9.29.9.2.(5) Table A-13 Table A-14 Table A-15
CSA	O437.0-93	OSB and Waferboard	9.23.14.2.(1) 9.23.14.4.(2) 9.23.15.2.(1) 9.23.15.3.(2) Table 9.23.16.2.A. 9.27.10.1.(1) 9.29.9.1.(2) 9.30.2.2.(1) Table A-13 Table A-14 Table A-15
CSA	S307-M1980	Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings	9.23.13.11.(5)
CSA	CAN/CSA-S406-92	Construction of Preserved Wood Foundations	9.13.2.8.(1); 9.15.2.4.(1) 9.16.5.1.(1)
CSA	Z240.2.1-09	Structural Requirements for Manufactured Homes	9.1.1.9.(1) 9.12.2.2.(6) 9.15.1.3.(1)
CSA	Z240.10.1-08	Site Preparation, Foundation and Anchorage of Manufactured Homes	9.15.1.3.(1) 9.23.6.3.(1)
CWC	2009	Engineering Guide for Wood Frame Construction	9.4.1.1.(1)
HI	2005	Hydronics Institute Manuals	6.2.1.1.(1)
HRAI	2005	Digest	6.2.1.1.(1) 6.2.4.3.(13)
HVI	HVI 915-2009	Procedure for Loudness Rating of Residential Fan Products	9.32.3.9.(2) Table 9.32.3.9.
HVI	HVI 916-2009	Airflow Test Procedure	9.32.3.9.(1)
MMAH	Supplementary Standard SA-1, November 24, 2013	Objectives and Functional Statements Attributed to the Acceptable Solutions	1.2.1.1.(1) of Division A 1.2.1.1.(2) of Division A
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
MMAH	Supplementary Standard SB-1, November 24, 2013	Climatic and Seismic Data	6.2.1.1.(1) 6.2.1.7.(1) 9.4.1.1.(3) 9.4.2.2.(1) Table 9.25.5.2. Table 9.32.3.10.A. 9.33.3.2.(1)
MMAH	Supplementary Standard SB-2, September 14, 2012	Fire Performance Ratings	9.10.3.1.(1) 9.10.3.2.(1) 9.10.5.1.(4) 9.10.9.9.(1) 9.10.13.14.(1)
MMAH	Supplementary Standard SB-3,September 14, 2012	Fire and Sound Resistance of Building Assemblies	9.10.3.1.(1) 9.10.5.1.(4) 9.11.2.1.(1) 9.11.2.1.(2)
MMAH	Supplementary Standard SB-7, September 14, 2012	Guards for Housing and Small Buildings	9.8.8.2.(5)
MMAH	Supplementary Standard SB-9, September 14, 2012	Requirements for Soil Gas Control	9.13.4.1.(1) 9.13.4.2.(2) to (4)
MMAH	Supplementary Standard SB-10, September 14, 2012	Energy Efficiency Requirements	Table 9.7.3.3.
MMAH	Supplementary Standard SB-12, November 24, 2013	Energy Efficiency for Housing	Table 9.7.3.3. 12.2.1.1.(3) 12.2.1.2.(3)
NFPA	72-2013	National Fire Alarm and Signaling Code	9.10.19.1.(2) 9.10.19.3.(3)
NFPA	80-2007	Fire Doors and Other Opening Protectives	9.10.9.6.(13) 9.10.13.1.(1)
NLGA	2007	Standard Grading Rules for Canadian Lumber	1.4.1.2.(1) of Division A 9.3.2.1.(1) Table 9.3.2.1. Tables A-1 to A-10
NRCan	January 2005, including all amendments, revisions and supplements effective to May 31, 2006	EnerGuide for New Houses: Administrative and Technical Procedures	12.2.1.1.(3) 12.2.1.2.(3)
SMACNA	ANSI/SMACNA 006-2006, 3rd Edition 2005	HVAC Duct Construction Standards - Metal and Flexible	6.2.1.1.(1) 6.2.4.2.(3) 6.2.4.3.(11) 6.2.4.3.(12)
TPIC	2007	Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses	9.23.13.11.(6)
Column 1	2	3	4

Table 1.3.1.2. (Cont'd)
Documents Referenced in the Building Code
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number	Title of Document[1]	Code Reference
UL	UL 2034-2008	Single and Multiple Station Carbon Monoxide Alarms	6.2.12.3.(1) 9.33.4.3.(1)
ULC	CAN/ULC-S101-07	Fire Endurance Tests of Building Construction and Materials	9.10.16.3.(1)
ULC	CAN/ULC-S109-03	Flame Tests of Flame-Resistant Fabrics and Films	6.2.4.9.(1)
ULC	ULC-S111-07	Fire Tests for Air Filter Units	6.2.4.14.(1)
ULC	CAN/ULC-S114-05	Test for Determination of Non-Combustibility in Building Materials	1.4.1.2.(1) of Division A
ULC	CAN/ULC-S115-05	Fire Tests of Firestop Systems	3.1.9.1.(1) 9.10.9.6.(2) 9.10.9.7.(3)
ULC	CAN/ULC-S524-06	Installation of Fire Alarm Systems	9.10.19.4.(3) 9.10.19.6.(2)
ULC	CAN/ULC-S531-02	Smoke Alarms	9.10.19.1.(1)
ULC	CAN/ULC-S553-02	Installation of Smoke Alarms	9.10.19.3.(2)
ULC	CAN/ULC-S610-M87	Factory-Built Fireplaces	9.22.8.1.(1)
ULC	ULC-S628-93	Fireplace Inserts	9.22.10.1.(1)
ULC	CAN/ULC-S629-M87	650°C Factory-Built Chimneys	9.21.1.2.(1)
ULC	CAN/ULC-S639-M87	Steel Liner Assemblies for Solid Fuel-Burning Masonry Fireplaces	9.22.2.3.(1)
ULC	CAN/ULC-S701-05	Thermal Insulation, Polystyrene, Boards and Pipe Covering	9.15.4.1.(1) Table 9.23.16.2.A. 9.25.2.2.(1) 9.25.2.2.(4)
ULC	CAN/ULC-S702-09	Mineral Fibre Thermal Insulation for Buildings	Table 9.23.16.2.A. 9.25.2.2.(1)
ULC	CAN/ULC-S703-01	Cellulose Fibre Insulation (CFI) for Buildings	9.25.2.2.(1)
ULC	CAN/ULC-S704-03	Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced	Table 9.23.16.2.A. 9.25.2.2.(1)
ULC	CAN/ULC-S705.1-01	Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material - Specification	9.25.2.2.(1)
ULC	CAN/ULC-S705.2-05	Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application	9.25.2.5.(1)
ULC	CAN/ULC-S706-02	Wood Fibre Thermal Insulation for Buildings	9.23.15.7.(3) Table 9.23.16.2.A. 9.25.2.2.(1) 9.29.8.1.(1)
ULC	CAN/ULC-S716.1-12	Exterior Insulation and Finish Systems (EIFS) – Materials and Systems	9.27.13.1.(1) 9.27.13.2.(1)
ULC	CAN/ULC-S716.2-12	Exterior Insulation and Finish Systems (EIFS) – Installation of EIFS Components and Water Resistive Barrier	9.27.13.3.(2)
ULC	CAN/ULC-S716.3-12	Exterior Insulation and Finish Systems (EIFS) – Design Application	9.27.13.3.(1)
Column 1	2	3	4

Notes to Table 1.3.1.2.:

(1) Some titles have been abridged to omit superfluous wording.

1.3.2. Abbreviations

1.3.2.1. Abbreviations of Proper Names (See Appendix A.)

(1) In this Code, an abbreviation of proper names listed in Column 1 of Table 1.3.2.1. has the meaning assigned opposite it in Column 2.

Table 1.3.2.1.
Abbreviations of Proper Names
Forming Part of Sentence 1.3.2.1.(1)

Abbreviation	Meaning
ACGIH	American Conference of Governmental Industrial Hygienists
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APHA	American Public Health Association
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	The American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BCMOH	British Columbia Ministry of Health
BNQ	Bureau de Normalisation du Québec
CAN	National Standard of Canada designation The number or name following the CAN designation represents the agency under whose auspices the standard is issued. CAN1 designates CGA, CAN2 designates CGSB, CAN3 designates CSA, and CAN4 designates ULC.
CCBFC	Canadian Commission on Building and Fire Codes
CGSB	Canadian General Standards Board
CSA	Canadian Standards Association
CWC	Canadian Wood Council
DBR	Division of Building Research, known as the Institute for Research in Construction since 1985
EPA	Environmental Protection Agency
FINA	Fédération Internationale de Natation
HI	Hydronics Institute
HRAI	Heating, Refrigerating and Air-Conditioning Institute of Canada
HUD	U.S. Department of Housing and Urban Development
HVI	Home Ventilating Institute
IESNA	Illuminating Engineering Society of North America
ISO	International Organization for Standardization
MMAH	Ontario Ministry of Municipal Affairs and Housing
MOE	Ontario Ministry of the Environment
NFPA	National Fire Protection Association
NLGA	National Lumber Grades Authority
NRCan	Natural Resources Canada
Column 1	2

Table 1.3.2.1. (Cont'd)
Abbreviations of Proper Names
Forming Part of Sentence 1.3.2.1.(1)

Abbreviation	Meaning
NSF	NSF International, formerly called National Sanitation Federation
SMACNA	Sheet Metal and Air Conditioning Contractors National Association Inc.
TC	Transport Canada
TPIC	Truss Plate Institute of Canada
UL	Underwriters Laboratories Inc.
ULC	Underwriters' Laboratories of Canada
USDA	United States Department of Agriculture
WEF	World Environment Federation
Column 1	2

Part 6

Heating, Ventilating and Air-Conditioning

Section 6.1. General (See Appendix A.)

6.1.1. Application

6.1.1.1. Scope

(1) The scope of this Part shall be as described in Subsection 1.1.2. of Division A.

6.1.1.2. Application

(1) This Part applies to systems and equipment for heating, ventilating and *air-conditioning* services.

Section 6.2. Design and Installation

6.2.1. General

6.2.1.1. Good Engineering Practice

(1) Heating, ventilating and *air-conditioning* systems, including related mechanical refrigeration systems, shall be designed, constructed and installed to conform to good engineering practice appropriate to the circumstances such as described in,

(a) the ASHRAE Handbooks as follows:
  - (i) Fundamentals,
  - (ii) Refrigeration,
  - (iii) HVAC Applications, and
  - (iv) HVAC Systems and Equipment

(b) CSA F280, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances", and the outside winter design temperatures shall conform to MMAH Supplementary Standard SB-1, "Climatic and Seismic Data",

(c) CAN/CSA-F326-M, "Residential Mechanical Ventilation Systems",

(e) the HRAI Digest,

(f) the Hydronics Institute Manuals, and

(g) the SMACNA Manuals

6.2.1.2. Design Indoor Air Temperatures

(1) *Buildings* classified as Group B, Division 2 or 3 *occupancies* or Group C *residential occupancies* that are intended for use in the winter months on a continuing basis shall be insulated and be equipped with heating facilities that are capable of maintaining an indoor air temperature of 22°C at the outside winter design temperature referred to in Article 6.2.1.7.

6.2.1.3. Structural Movement (See Appendix A.)

(1) Mechanical systems and equipment shall be designed and installed to accommodate the maximum relative structural movement provided for in the *construction* of the *building*.

6.2.1.4. Installation Standards

(1) The installation of solid fuel-burning *appliances* for central heating systems shall comply with CAN/CSA-B365, "Installation Code for Solid Fuel-Burning Appliances and Equipment" and the manufacturer's installation instructions.

(2) The solid fuel-fired *appliances* in Sentence (1) shall conform to CAN/CSA-B366.1, "Solid Fuel-Fired Central Heating Appliances".

(3) The design and installation of earth energy systems shall conform to CAN/CSA-C448.2, "Design and Installation of Earth Energy Systems for Residential and Other Small Buildings", where such systems use groundwater, submerged heat exchangers or ground heat exchangers to serve,
(a) single *dwelling units*, or
(b) *buildings* where the *conditioned space* is not more than 1 400 m².

(5) The design and installation of solid fuel-burning *stoves*, ranges and *space heaters*, including the requirements for combustion air, shall conform to the requirements of CAN/CSA-B365, "Installation Code for Solid Fuel-Burning Appliances and Equipment" and the manufacturer's installation instructions.

(6) The design and installation of hydronic heating systems shall conform to,
(a) CAN/CSA-B214, "Installation Code for Hydronic Heating Systems", or
(b) good engineering practice appropriate to the circumstances such as described in Article 6.2.1.1.

(7) Solid fuel-burning *stoves*, *furnaces* and hydronic heating systems designed to burn solid fuels, other than coal, shall conform to the particulate emission limits of,
(a) CSA B415.1, "Performance Testing of Solid-Fuel-Burning Heating Appliances", or
(b) the "Standards of Performance for New Residential Wood Heaters", set out in Subpart AAA of Part 60 of Title 40 of the Code of Federal Regulations, published by the United States Environmental Protection Agency, as it read on November 1, 2013.

6.2.1.5. Fireplaces

(1) Fireplaces shall conform to the requirements of Section 9.22.

6.2.1.6. Heat Recovery Ventilators

(1) Except as provided in Sentence (2), heat recovery ventilators with rated capacities of not less than 25 L/s and not more than 200 L/s shall be installed in accordance with Article 9.32.3.11.

(2) Where *electric space heating*, other than forced-air electric heating system, is provided in *buildings* of *residential occupancy* within the scope of Part 9, the mechanical ventilation system shall include heat recovery ventilators designed to provide the greater of,
(a) the minimum rated efficiency required by the *Green Energy Act, 2009*, or
(b) a minimum 55% sensible heat recovery efficiency when tested to the low temperature thermal and ventilation performance test method set out in CAN/CSA-C439, "Rating the Performance of Heat/Energy-Recovery Ventilators", at a Station 1 test temperature of -25°C at an air flow not less than 30 L/s.

6.2.1.7. Outside Design Conditions

(1) The outside conditions to be used in designing heating, ventilating and *air-conditioning* systems shall be determined in conformance with MMAH Supplementary Standard SB-1, "Climatic and Seismic Data".

6.2.1.8. Installation – General

(1) Equipment requiring periodic maintenance and forming part of a heating, ventilating or *air-conditioning* system shall be installed with provision for access for inspection, maintenance, repair and cleaning. (See Appendix A.)

(2) Mechanical equipment shall be provided with guards to prevent injury.

(3) Heating, ventilating or *air-conditioning* systems shall be protected from freezing if they may be adversely affected by freezing temperatures.

6.2.1.9. Expansion, Contraction and System Pressure

(1) Heating and cooling systems shall be designed to allow for expansion and contraction of the heat transfer fluid and to maintain the system pressure within the rated working pressure limits of all components of the system.

6.2.1.10. Asbestos

(1) Asbestos shall not be used in air distribution systems or equipment in a form or in a location where asbestos fibres could enter the air supply or return systems.

6.2.1.11. Access Openings

(1) Any covering of an access opening through which a person could enter shall be openable from the inside without the use of keys where there is a possibility of the opening being accidentally closed while the system or equipment is being serviced.

6.2.1.12. Combustible Tubing

(1) *Combustible* tubing for pneumatic controls may be used in *buildings* required to be of *noncombustible construction* provided it has an outside diameter not exceeding 10 mm.

6.2.2. Ventilation

6.2.2.1. Required Ventilation

(1) Except as provided in Sentence (3), all *buildings* shall be ventilated in accordance with this Part.

(2) Except in *storage garages* and *repair garages* covered by Article 6.2.2.3., the rates at which outdoor air is supplied in *buildings* by ventilation systems shall be not less than the rates required by ANSI/ASHRAE 62.1, "Ventilation for Acceptable Indoor Air Quality". (See Appendix A.)

(3) Self-contained mechanical ventilation systems serving only one *dwelling unit* shall conform to,
(a) this Part, or
(b) Subsection 9.32.3.
(See Appendix A.)

6.2.2.4. Air Contaminants

(3) Heating, ventilating and *air-conditioning* systems shall be designed to minimize growth of micro-organisms according to good engineering practice as described in 6.2.1.1.(1). (See Appendix A.)

6.2.2.7. Crawl Spaces and Attic or Roof Spaces

(1) Every crawl space and every *attic or roof space* shall be ventilated by natural or mechanical means. (See Appendix A.)

6.2.4. Air Ducts for Low Capacity Systems

6.2.4.1. Application

(1) The requirements of this Subsection apply to the design, construction and installation of air duct distribution systems serving heating, ventilating and *air-conditioning* systems that serve individual *dwelling units* within the scope of Part 9.

6.2.4.2. Duct Design

(1) Materials in *supply ducts* shall conform to Article 6.2.3.2.

(2) Galvanized steel or aluminum *supply ducts* shall conform to Table 6.2.4.2.

(3) The design of fitting for ducts shall conform to SMACNA, "HVAC Duct Construction Standards – Metal and Flexible", except that metal thickness shall conform to Table 6.2.4.2.

Table 6.2.4.2.
Minimum Metal Thickness of Ducts
Forming Part of Sentences 6.2.4.2.(2) and (3)

Type of Duct	Maximum Diameter, mm	Maximum Width or Depth, mm	Minimum Metal Thickness, mm	
			Duct Material	
			Galvanized Steel	Aluminum
Round ducts serving single dwelling units	125 or less	—	0.254	0.30
Round	350	—	0.33	0.30
	over 350	—	0.41	0.41
Rectangular, enclosed	—	350	0.33	0.30
	—	over 350	0.41	0.41
Rectangular, not enclosed, for single dwelling units, with required clearance up to 12 mm	—	350	0.33	0.41
	—	over 350	0.41	0.48
Rectangular, not enclosed, with required clearance of more than 12 mm	—	350	0.41	0.41
	—	over 350	0.48	0.48
Column 1	2	3	4	5

6.2.4.3. Construction and Installation of Ducts and Plenums

(1) Rectangular panels in *plenums* and ducts more than 300 mm wide shall be shaped to provide sufficient stiffness.

(2) Where the installation of heating *supply ducts* in walls and floors creates a space between the duct and construction material, the space shall be fire stopped with *noncombustible* material at each end.

(3) Ducts shall be securely supported by metal hangers, straps, lugs or brackets, except that where zero clearance is permitted, wooden brackets may be used.

(4) All round duct joints shall be tight-fitting and lapped not less than 25 mm.

(5) Rectangular duct connections shall be made with S and drive cleats.

(6) Trunk *supply ducts* shall not be nailed directly to wood members.

(7) Branch ducts shall be supported at suitable spacings to maintain alignment and prevent sagging.

(8) *Combustible* ducts in concrete slabs-on-ground that are connected to a *furnace* supply *plenum* shall be located not closer than 600 mm to that *plenum* and not less than 600 mm from its connection to a riser or register.

(9) Ducts in or beneath concrete slabs-on-ground shall be watertight, corrosion-, decay- and mildew-resistant.

(10) Where a *supply duct* or *return duct* is not protected by an insulated exterior wall or where the duct is exposed to an unheated space it shall be insulated to provide a thermal resistance of not less than RSI 2.1.

(11) Where a *supply duct* or *return duct* is located in an unconditioned space or outdoors, all joints of the ductwork shall be sealed to a Class A seal level in accordance with the SMACNA, "HVAC Duct Construction Standards – Metal and Flexible".

(12) Where a *supply duct* is located in a conditioned space, the ductwork shall be sealed to a Class C seal level in accordance with the SMACNA, "HVAC Duct Construction Standards – Metal and Flexible".

(13) Underground ducts shall,
(a) be constructed and installed with a slope to provide interior drainage to all low points,
(b) not be connected directly to a sewer, and
(c) be installed and constructed of materials in conformance with ASHRAE Handbooks, SMACNA Manuals and the HRAI Digest.

(14) A clean-out or pump-out connection shall be provided in an underground duct system at every low point of the duct system.

6.2.4.4. Warm-Air Supply Outlets (See Appendix A.)

(1) In a *dwelling unit*, a warm-air supply outlet shall be provided in each finished room that is located adjacent to unheated space, exterior air or exterior soil.

(2) Except as provided in Sentence (3), when a room described in Sentence (1) is located adjacent to exterior walls, such outlets shall be located so as to bathe at least one exterior wall or window with warm air, except in bathrooms, utility rooms or kitchens, where this may not be practical.

(3) Where the heating system is also designed to provide ventilation air, ceiling outlets or outlets located high on interior walls may be installed, provided the outlets are,
(a) designed for this purpose, and
(b) installed with diffusers.

(4) At least one warm-air supply outlet shall be provided for each 40 m^2 of floor surface area in unfinished *basements* serving *dwelling units*, located so as to provide adequate distribution of warm air throughout the *basement*.

(5) At least one warm-air supply outlet shall be provided for each 80 m^2 of floor surface area in heated crawl spaces serving *dwelling units*, and it shall be located so as to provide adequate distribution of warm-air throughout the crawl space.

(6) Except for pipeless *furnaces* and floor *furnaces*, the capacity of warm-air supply outlets serving *dwelling units* shall be not less than the design heat loss from the area served and shall not exceed 3 kW per outlet.

(7) In *basements* and heated crawl spaces, the calculated heat gain from the *supply ducts* and *plenum* surfaces may be considered in calculating the design heat loss.

(8) The temperature of supply air at the warm-air supply outlets shall not exceed 70°C.

(9) Warm-air supply outlets located in finished areas shall be provided with diffusers and adjustable openings and shall not be located on a *furnace plenum*.

(10) Air duct systems serving *storage garages* shall not be interconnected with other parts of the *building*.

6.2.4.6. Adjustable Dampers and Balance Stops

(1) All branch *supply ducts* for residential systems shall be equipped with volume control dampers at the boot to permit balancing or shall be fitted with a diffuser incorporating an adjustable and lockable volume control device that can be set in a fixed position.

6.2.4.7. Return-Air System

(1) The return-air system shall be designed to handle the entire air supply.

(2) Except as provided in Sentences (3) and (4), *return ducts* shall be constructed of material having a surface *flame-spread rating* of not more than 150.

(3) Where any part of a *return duct* will be exposed to radiation from the heat exchanger or other radiating part within the *furnace*, such part of a *return duct* directly above or within 600 mm of the outside *furnace* casing shall be *noncombustible*. (See Appendix A.)

(4) *Return ducts* serving solid fuel-fired *furnaces* shall be constructed of *noncombustible* material.

(5) *Combustible return ducts* shall be lined with *noncombustible* material below floor registers, at the bottom of vertical ducts and under *furnaces* having a bottom return.

(6) Spaces between studs and joists used as *return ducts* shall be separated from the unused portions of such spaces by tight-fitting metal stops or wood blocking.

(7) A vertical *return duct* shall have openings to return air on not more than 1 floor.

(8) A *public corridor* shall comply with Sentences 6.2.3.9.(4) and (5).

(9) The return-air system shall be designed so that the negative pressure from the circulating fan cannot affect the *furnace* combustion air supply nor draw combustion products from joints or openings in the *furnace* or *flue pipe*.

(10) Return-air from a *dwelling unit* shall not be recirculated to any other *dwelling unit*.

(11) Except for floor levels that are less than 900 mm above or below an adjacent floor level that is provided with a return-air inlet, at least one return-air inlet shall be provided in each floor level in a *dwelling unit*.

(12) Provision shall be made for the return of air from all rooms by leaving gaps beneath doors, using louvred doors or installing *return duct* inlets.

(13) Return-air inlets shall not be installed in an enclosed room or crawl space that provides combustion air to a *furnace*.

6.2.4.8. Coverings, Linings and Insulation

(1) Foamed plastic insulation may be used in a ceiling space that acts as a return air *plenum*, provided the foamed plastic insulation is protected from exposure to the *plenum* in accordance with Article 3.1.5.12.

(2) Linings of ducts shall be installed so that they will not interfere with the operation of volume or balancing dampers.

6.2.4.9. Tape

(1) Tape used for sealing joints in air ducts, *plenums* and other parts of air duct systems shall meet the flame-resistance requirements for fabric in CAN/ULC-S109, "Flame Tests of Flame-Resistant Fabrics and Films".

6.2.4.10. Clearances of Ducts and Plenums (See Appendix A.)

(1) Where the *plenum* clearance is 75 mm or less, the clearance between a *supply duct* and *combustible* material shall,
(a) be equal to the required *plenum* clearance within 450 mm of the *plenum*, and
(b) be not less than 12 mm at a distance of 450 mm or more from the *plenum*, except that this clearance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the *furnace* heat exchanger.

(2) Where the *plenum* clearance is more than 75 mm but not more than 150 mm, the clearance between a *supply duct* and *combustible* material shall,
(a) be equal to the required *plenum* clearance within a horizontal distance of 1 800 mm of the *plenum*, and
(b) be not less than 12 mm at a horizontal distance of 1 800 mm or more from the *plenum*, except that this distance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the *furnace* heat exchanger.

(3) Where the *plenum* clearance is more than 150 mm, the clearance between a *supply duct* and *combustible* material shall,
(a) be equal to the required *plenum* clearance within a horizontal distance of 1 000 mm of the *plenum*,
(b) be not less than 150 mm within a horizontal distance between 1 000 mm and 1 800 mm from the *plenum*, and
(c) be not less than 25 mm at a horizontal distance of 1 800 mm or more from the *plenum*, except that this distance may be reduced to 8 mm beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger.

(4) Where a register is installed in a floor directly over a pipeless *furnace*, a double-walled register box with not less than 100 mm between walls, or a register box with the warm-air passage completely surrounded by the cold-air passage, shall be permitted in lieu of the clearances listed in Sentences (1), (2) and (3).

6.2.4.11. Exhaust Ducts and Outlets

(1) Where an *exhaust duct* passes through or is adjacent to unheated space, the duct shall be insulated to prevent moisture or condensation in the duct.

(2) Exhaust outlets shall be designed to prevent back draft under wind conditions.

(3) *Exhaust ducts* directly connected to laundry drying equipment shall be independent of other *exhaust ducts*.

(4) Exhaust systems shall discharge directly to the outdoors.

6.2.4.12. Make-Up Air

(1) In ventilating systems that exhaust air to the outdoors, provision shall be made for the admission of a supply of make-up air in sufficient quantity so that the operation of the exhaust system and other exhaust equipment or combustion equipment is not adversely affected.

6.2.4.13. Supply, Return, Intake and Exhaust Air Openings

(1) Supply, return and exhaust air openings in rooms or spaces shall be protected by grilles having openings of a size that will not allow the passage of a 15 mm diameter sphere.

(2) Outdoor air intakes and exhaust outlets at the *building* exterior shall be designed or located so that the air entering the *building* system will not contain more contaminants than the normal exterior air.

(3) Exterior openings for outdoor air intakes and exhaust outlets shall be shielded from the entry of snow and rain and shall be fitted with corrosion-resistant screens of mesh having openings not larger than 15 mm, except where climatic conditions may require larger openings.

(4) Screens required in Sentence (3) shall be accessible for maintenance.

(5) *Combustible* grilles, diffusers and other devices for the supply and return air openings installed in walls and ceilings shall have a *flame-spread rating* of,
(a) not more than 200 in bathrooms, and
(b) not more than 150 in rooms or spaces other than bathrooms.

6.2.4.14. Air Filters and Equipment

(1) Air filters for air duct systems shall conform to the requirements for Class 2 air filter units as described in ULC-S111, "Fire Tests For Air Filter Units".

(2) When electrostatic-type filters are used, they shall be installed so as to ensure that the electric circuit is automatically de-energized when filter access doors are opened or when the system circulating fan is not operating.

(3) When odour removal equipment of the adsorption type is used it shall be,
(a) installed to provide access so that adsorption material can be reactivated or renewed, and
(b) protected from dust accumulation by air filters installed on the inlet side.

6.2.5. Heating Appliances, General

6.2.5.1. Location of Appliances

(1) Except for *appliances* installed in *dwelling units*, fuel-fired heating *appliances* shall be located, enclosed or separated from the remainder of the *building* in conformance with Section 3.6.

6.2.5.2. Appliances Installed Outside the Building

(1) Fuel-fired *appliances* installed outside a *building* shall be,
(a) designed and constructed for outdoor use,
(b) installed not less than 1 200 mm from the property line, measured horizontally, and
(c) installed not less than 3 m from an adjacent wall of the same *building* when such wall contains an opening or openings within 3 *storeys* above and 5 m horizontally from the *appliance*, unless such openings are protected by a *closure* assembly having a 45 min *fire-protection rating* determined in conformance with Article 3.1.8.4., or by wired glass conforming to Article 3.1.8.14.

6.2.7. Unit Heaters

6.2.7.1. Clearances

(1) Every *unit heater* using either steam or hot water as the heating medium shall be installed such that the clearances between the *appliance* and adjacent *combustible* material conform to Table 6.2.9.3.

6.2.8. Radiators and Convectors

6.2.8.1. Lining or Backing

(1) Every steam or hot water radiator and convector located in a recess or concealed space or attached to the face of a wall of *combustible construction* shall be provided with a *noncombustible* lining or backing.

(2) Every steam or hot water radiator and convector shall be installed to conform to the clearance requirements of Table 6.2.9.3.

6.2.9. Piping for Heating and Cooling Systems

6.2.9.1. Piping Materials and Installation

(1) Piping shall be made from materials designed to withstand the effects of temperatures and pressures that may occur in the system.

(2) Every pipe used in a heating or *air-conditioning* system shall be installed to allow for expansion and contraction due to temperature changes.

(3) Supports and anchors for piping in a heating or *air-conditioning* system shall be designed and installed to ensure that undue stress is not placed on the supporting structure.

6.2.9.2. Insulation and Coverings

(1) Insulation and coverings on pipes shall be composed of material suitable for the operating temperature of the system to withstand deterioration from softening, melting, mildew and mould.

(2) Insulation and coverings on pipes in which the temperature of the fluid exceeds 120°C,
(a) shall be made of *noncombustible* material, or
(b) shall not flame, glow, smoulder or smoke when tested in accordance with ASTM C411, "Hot-Surface Performance of High-Temperature Thermal Insulation", at the maximum temperature to which such insulation or covering is to be exposed in service.

(3) Except as provided in Sentence (7), where *combustible* insulation is used on piping in a *horizontal* or *vertical service space*, the insulation and coverings on such pipes shall have a *flame-spread rating* throughout the material of not more than 25 in *buildings* of *noncombustible construction* and not more than 75 in *buildings* of *combustible construction*.

(4) Except as provided in Sentence (7), insulation and coverings on piping located in rooms and spaces other than the *service spaces* described in Sentence (3) shall have a *flame-spread rating* of not more than that required for the interior finish for the ceiling of the room or space.

(5) Except as provided in Sentence (7), where *combustible* insulation and covering is used on piping in *buildings* described in Subsection 3.2.6., they shall have a smoke developed classification of not more than 100.

(6) Exposed piping or equipment subject to human contact shall be insulated so that the temperature of the exposed surface does not exceed 70°C. (See Appendix A.)

(7) No *flame-spread rating* or smoke developed classification limitations are required where *combustible* insulation and coverings are used on piping when such piping is,
(a) located within a concealed space in a wall,
(b) located in a floor slab, or
(c) enclosed in a *noncombustible* raceway or conduit.

6.2.9.3. Clearances

(1) Clearances between *combustible* material and bare pipes carrying steam or hot water shall conform to Table 6.2.9.3.

Table 6.2.9.3.
Clearance Between Steam or Hot Water Pipes and Combustible Material
Forming Part of Sentences 6.2.7.1.(1), 6.2.8.1.(2) and 6.2.9.3.(1)

Steam or Water Temperature, °C	Minimum Clearance, mm
not above 95	no clearance
above 95 to 120	15
above 120	25
Column 1	2

6.2.9.4. Surface Temperature

(1) The exposed surface temperature of a steam or hot water radiator shall not exceed 70°C unless precautions are taken to prevent human contact.

6.2.9.5. Protection

(1) Where a pipe carrying steam or hot water at a temperature above 120°C passes through a *combustible* floor, ceiling or wall, the construction shall be protected by a sleeve of metal or other *noncombustible* material not less than 50 mm larger in diameter than the pipe.

(2) Unprotected steam or hot water pipes that pass through a storage space shall be covered with not less than 25 mm of *noncombustible* insulation to prevent direct contact with the material stored.

6.2.9.6. Piping in Shafts

(1) Where piping for heating or *air-conditioning* systems is enclosed in a shaft, the requirements of Article 3.6.3.1. for shafts shall apply.

6.2.10. Refrigerating Systems and Equipment for Air-Conditioning

6.2.10.1. Cooling Units

(1) Where a cooling unit is combined with a fuel-fired *furnace* in the same duct system, the cooling unit shall be installed,
(a) in parallel with the heating *furnace*,
(b) upstream of the *furnace*, provided the *furnace* is designed for such application, or
(c) downstream of the *furnace*, provided the cooling unit is designed to prevent excessive temperature or pressure in the refrigeration system.

6.2.11. Storage Bins

6.2.11.1. Storage Bins

(1) Service pipes passing through a storage bin for solid fuel shall be protected or so located as to avoid damage to the pipes.

(2) Except for fuel-thawing pipes, every pipe designed to operate at a temperature of 50°C or above shall be located where fuel cannot be stored in contact with it.

(3) A storage bin for solid fuel shall not be located above a sewer opening or drain opening.

(4) Storage bins for solid fuel shall be designed and constructed so that the air temperature in the bin or the surface temperature of any part of the floor or walls is below 50°C.

6.2.11.2. Ash Storage Bins

(1) Every ash storage bin shall be constructed of *noncombustible* material.

(2) Every opening in an ash storage bin shall be protected by a tight-fitting metal door with metal frame securely fastened to the bin.

6.2.12. Carbon Monoxide Alarms

6.2.12.1. Application

(1) This Subsection applies to every *building* that,
(a) contains a *residential occupancy*, and
(b) contains a fuel-burning *appliance* or a *storage garage*.

6.2.12.2. Location of Carbon Monoxide Alarms

(1) Where a fuel-burning *appliance* is installed in a *suite* of *residential occupancy*, a carbon monoxide alarm shall be installed adjacent to each sleeping area in the *suite*.

(3) Where a *storage garage* is located in a *building* containing a *residential occupancy*, a carbon monoxide alarm shall be installed adjacent to each sleeping area in every *suite* of *residential occupancy* that is adjacent to the *storage garage*.

6.2.12.3. Installation and Conformance to Standards

(1) The carbon monoxide alarms required by Article 6.2.12.2. shall,
(a) except as permitted in Sentence (2), be permanently connected to an electrical circuit and shall have no disconnect switch between the overcurrent device and the carbon monoxide alarm,
(b) be wired so that its activation will activate all carbon monoxide alarms within the *suite*, where located within a *suite* of *residential occupancy*,
(c) be equipped with an alarm that is audible within bedrooms when the intervening doors are closed, where located in a *suite* of *residential occupancy*, and
(d) conform to,
  (i) CAN/CSA-6.19, "Residential Carbon Monoxide Alarming Devices", or
  (ii) UL 2034, "Single and Multiple Station Carbon Monoxide Alarms".

(2) Where the *building* is not supplied with electrical power, carbon monoxide alarms are permitted to be battery operated.

Section 6.3. Chimneys and Venting Equipment

6.3.1. General

6.3.1.1. Requirement for Venting

(1) Except as provided in Articles 6.3.1.2. and 6.3.1.3., the products of combustion from solid fuel-burning *appliances* shall be vented in conformance with the requirements in the applicable *appliance* installation standards listed in Article 6.2.1.4.

6.3.1.2. Masonry or Concrete Chimneys

(1) Rectangular *masonry or concrete chimneys* not more than 12 m in height shall conform to Part 9 if they serve,
(a) *appliances* with a combined total rated heat output of 120 kW or less, or
(b) fireplaces.

(2) *Masonry or concrete chimneys* other than those described in Sentence (1) shall be designed and installed in conformance with the appropriate requirements in NFPA 211, "Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances".

6.3.1.3. Metal Smoke Stacks

(1) Single wall metal smoke stacks shall be designed and installed in conformance with NFPA 211, "Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances".

Part 9

Housing and Small Buildings

Section 9.1. General

9.1.1. Application

9.1.1.1. Scope

(1) The scope of this Part shall be as described in Subsection 1.1.2. of Division A.

9.1.1.5. Proximity to Existing Above Ground Electrical Conductors

(1) Where a *building* is constructed in close proximity to existing above ground electrical conductors, the requirements of Subsection 3.1.19. shall apply.

9.1.1.7. Radon

(1) In addition to all other requirements, a *building* in the following designated areas shall be designed and constructed so that the annual average concentration of radon 222 does not exceed 200 Bq/m^3 of air and the annual average concentration of the short lived daughters of radon 222 does not exceed 0.02 working levels inside the *building* for,
(a) the City of Elliot Lake in the Territorial District of Algoma,
(b) the Township of Faraday in the County of Hastings, and
(c) the geographic Township of Hyman in the Territorial District of Sudbury.

9.1.1.8. Building in Flood Plains

(1) *Buildings* constructed on flood plains shall,
(a) be designed and constructed in accordance with good engineering practice to withstand anticipated vertical and horizontal hydrostatic pressures acting on the structure, and
(b) incorporate floodproofing measures that will preserve the integrity of *exits* and *means of egress* during times of flooding.

9.1.1.9. Site Assembled and Factory-Built Buildings (See Appendix A.)

(1) Except as provided in Sentence (2), a manufactured *building* intended for *residential occupancy* is deemed to comply with this Code if it is designed and constructed in compliance with,
(a) CSA Z240.2.1, "Structural Requirements for Manufactured Homes", if the *building* is constructed in sections not wider than 4.88 m, or
(b) CSA A277, "Procedures for Factory Certification of Buildings".

(2) The requirements of this Code shall apply to,
(a) *building* components designed and constructed outside the place of manufacture, and
(b) site installation of such *buildings*.

Section 9.3. Materials, Systems and Equipment

9.3.1. Concrete

9.3.1.1. General

(1) Except as provided in Sentence (2), unreinforced and nominally reinforced concrete shall be designed, mixed, placed, cured and tested in accordance with the requirements for "R" class concrete stated in Clause 8.13 of CSA A23.1, "Concrete Materials and Methods of Concrete Construction".

(2) Unreinforced and nominally reinforced site-batched concrete shall be designed, mixed, placed and cured in accordance with Articles 9.3.1.2. to 9.3.1.9.

(3) Except as provided in Sentence (4), Subsection 9.15.4. and Section 9.39., reinforced concrete shall be designed to conform to the requirements of Part 4.

(4) For flat insulating concrete form walls not exceeding 2 *storeys* in *building height*, and having a maximum floor to floor height of 3 m, in *buildings* of light-frame construction containing only a single *dwelling unit*, the concrete and reinforcing shall comply with Part 4 or,
(a) the concrete shall conform to CSA A23.1, "Concrete Materials and Methods of Concrete Construction", with a maximum aggregate size of 19 mm, and
(b) the reinforcing shall,
  (i) conform to CAN/CSA-G30.18-M, "Billet - Steel Bars for Concrete Reinforcement",
  (ii) have a minimum specified yield strength of 400 MPa, and
  (iii) be lapped a minimum of 450 mm for 10M bars and 650 mm for 15M bars.

9.3.1.2. Cement

(1) Cement shall meet the requirements of CAN/CSA-A3001, "Cementitious Materials for Use in Concrete".

9.3.1.3. Concrete in Contact With Sulfate Soil

(1) Concrete in contact with sulfate *soil*, which is deleterious to normal cement, shall conform to the requirements in Clause 4.1.1.6. of CSA A23.1, "Concrete Materials and Methods of Concrete Construction".

9.3.1.4. Aggregates

(1) Aggregates shall,
(a) consist of sand, gravel, crushed rock, crushed air-cooled blast furnace slag, expanded shale or expanded clay conforming to CSA A23.1, "Concrete Materials and Methods of Concrete Construction", and
(b) be clean, well-graded and free of injurious amounts of organic and other deleterious material.

9.3.1.5. Water

(1) Water shall be clean and free of injurious amounts of oil, organic matter, sediment or any other deleterious material.

9.3.1.6. Compressive Strength

(1) Except as provided elsewhere in this Part, the compressive strength of unreinforced concrete after 28 days shall be not less than,
(a) 32 MPa for garage floors, carport floors and all exterior flatwork,
(b) 20 MPa for interior floors other than those for garages and carports, and
(c) 15 MPa for all other applications.

(2) Concrete used for garage and carport floors and exterior steps shall have air entrainment of 5 to 8%.

9.3.1.7. Concrete Mixes

(1) For site-batched concrete, the concrete mixes described in Table 9.3.1.7. shall be considered acceptable if the ratio of water to cementing materials does not exceed,
(a) 0.45 for garage floors, carport floors and all exterior flatwork,
(b) 0.65 for interior floors other than those for garages and carports, and
(c) 0.70 for all other applications.

(2) The size of aggregate in unreinforced concrete mixes referred to in Sentence (1) shall not exceed,
(a) 1/5 the distance between the sides of vertical forms, or
(b) 1/3 the thickness of flatwork.

Table 9.3.1.7.
Concrete Mixes
Forming Part of Sentence 9.3.1.7.(1)

Maximum Size of Coarse Aggregate, mm	Materials, volume					
	Cement		Fine Aggregate (damp average coarse sand)		Coarse Aggregate (gravel or crushed stone)	
	Parts	L[(1)]	Parts	L	Parts	L
14	1	28	1.75	49	2	56
20	1	28	1.75	49	2.5	70
28	1	28	2	56	3	84
40	1	28	2	56	3.5	98
Column 1	2	3	4	5	6	7

Notes to Table 9.3.1.7.:
(1) A 40 kg bag of cement contains 28 L.

9.3.1.8. Admixtures

(1) Admixtures shall conform to ASTM C260, "Air-Entraining Admixtures for Concrete", or ASTM C494 / C494M, "Chemical Admixtures for Concrete", as applicable.

9.3.1.9. Cold Weather Requirements

(1) When the air temperature is below 5°C , concrete shall be,
(a) kept at a temperature of not less than 10°C or more than 25°C while being mixed and placed, and
(b) maintained at a temperature of not less than 10°C for 72 h after placing.

(2) No frozen material or ice shall be used in concrete described in Sentence (1).

9.3.2. Lumber and Wood Products

9.3.2.1. Grade Marking

(1) Lumber for joists, rafters, trusses and beams and for the uses listed in Table 9.3.2.1. shall be identified by a grade stamp to indicate its grade as determined by the NLGA, "Standard Grading Rules for Canadian Lumber". (See Appendix A.)

Table 9.3.2.1.
Minimum Lumber Grades for Specific End Uses[1]
Forming Part of Sentences 9.3.2.1.(1) and 9.3.2.2.(1)

Use	Boards			Framing
	Paragraph in the NLGA Grading Rules Under Which Boards are Graded			All Species
	All Species		Eastern White Pine & Red Pine	
	Para 113	Para 114	Para 118	
Stud wall framing (loadbearing members)	—	—	—	Stud, Standard, No. 2
Stud wall framing (non-loadbearing members)	—	—	—	Stud, Utility, No. 3
Plank frame construction (loadbearing members)	No. 3 Common	—	No. 3 Common	No. 2
Plank frame construction (non-loadbearing members)	No. 5 Common	—	No. 5 Common	Economy, No. 3
Post and beams less than 114 mm in thickness	—	—	—	Standard, No.2
Post and beams not less than 114 mm in thickness	—	—	—	Standard
Roof sheathing	No. 3 Common	Standard	No. 4 Common	—
Subflooring	No. 3 Common	Standard	No. 3 Common	—
Wall sheathing when required as a nailing base	No. 4 Common	Utility	No. 4 Common	—
Wall sheathing not required as a nailing base	No. 5 Common	Economy	No. 5 Common	—
Column 1	2	3	4	5

Notes to Table 9.3.2.1.:
(1) See Appendix A.

9.3.2.2. Lumber Grades

(1) Except for joists, rafters, trusses and beams, visually graded lumber shall conform to the grades in Table 9.3.2.1.

9.3.2.3. Machine Stress Rated Lumber

(1) Machine stress rated lumber shall conform to the requirements of Subsection 4.3.1.

9.3.2.4. OSB, Waferboard and Plywood Marking

(1) OSB, waferboard and plywood used for roof sheathing, wall sheathing and subflooring shall be legibly identified on the face of the material indicating,
(a) the manufacturer of the material,
(b) the standard to which it is produced, and
(c) that the material is of an exterior type.

9.3.2.5. Moisture Content

(1) Moisture content of lumber shall be not more than 19% at the time of installation.

9.3.2.6. Lumber Dimensions

(1) Lumber dimensions referred to in this Part are actual dimensions determined in conformance with CSA O141, "Softwood Lumber".

9.3.2.7. Panel Thickness Tolerances

(1) The thickness specified in this Part for plywood, hardboard, particleboard, OSB and waferboard shall be subject to the tolerances permitted in the standards referenced for these products unless specifically indicated in this Part.

9.3.2.8. Undersized Lumber

(1) Joist, rafter, lintel and beam members up to 5% less than the actual Canadian standard sizes are permitted to be used provided the allowable spans for the grade and species of lumber under consideration are reduced 5% from those shown in the span tables for full size members. (See Appendix A.)

9.3.2.9. Termite and Decay Protection

(1) In localities where termites are known to occur,
(a) clearance between structural wood elements and the finished ground level directly below them shall be not less than 450 mm and, except as provided in Sentence (2), all sides of the supporting elements shall be visible to permit inspection, or
(b) structural wood elements, supported by elements in contact with the ground or exposed over bare soil, shall be pressure-treated with a chemical that is toxic to termites.

(2) In localities where termites are known to occur and *foundations* are insulated or otherwise finished in a manner that could conceal a termite infestation,
(a) a metal or plastic barrier shall be installed through the insulation and any other separation or finish materials above finished ground level to control the passage of termites behind or through the insulation, separation or finish materials, and
(b) all sides of the finished supporting assembly shall be visible to permit inspection.

(3) Structural wood elements shall be pressure-treated with a preservative to resist decay, where the vertical clearance between structural wood elements and the finished ground level is less than 150 mm. (See Appendix A.)

(4) In localities where termites are known to occur and where windows or other openings at or below *grade* contain wood elements, the bottom of window wells or adjacent ground shall be at least 150 mm below the nearest wood unless the wood is pressure-treated with a chemical toxic to termites. (See Appendix A.)

(5) Structural wood elements used in retaining walls and cribbing shall be pressure-treated with a preservative to resist decay, where,
(a) the retaining wall or cribbing supports ground that is critical to the stability of *building foundations*, or
(b) the retaining wall or cribbing is greater than 1.2 m in height.

(6) Where wood is required by this Article to be treated to resist termites or decay, such treatment shall be in accordance with Table 2, "Use Categories for Specific Products, Uses, and Exposures", of CAN/CSA-O80.1, "Specification of Treated Wood", as follows:
(a) Use Category 1, where the wood member is used in,
  (i) interior construction,
  (ii) above-ground applications, and
  (iii) applications where the wood member remains dry,
(b) Use Category 2, where the wood member is used in,
  (i) interior construction,
  (ii) above-ground applications, and
  (iii) applications where the wood member may be subjected to occasional sources of moisture,
(c) Use Category 3.2, where the wood member is used in,
  (i) exterior construction,
  (ii) above-ground applications, and
  (iii) applications where the wood member is uncoated or is used in a configuration conducive to moisture accumulation,

(d) Use Category 4.1, where,
(i) the wood member is used in contact with the ground,
(ii) the wood member is used in contact with fresh water, or
(iii) the vertical clearance between the wood element and the finished ground level is less than 150 mm and the wood elements are not separated from permeable supporting materials by a moisture barrier, or
(e) Use Category 4.2, where the wood member is used in critical structural components, including permanent wood *foundations*.

(7) Where wood is protected in accordance with Use Category 1 or Use Category 2 using an inorganic boron preservative, the wood shall be,
(a) protected from direct exposure to water during and after the completion of construction, and
(b) separated from permeable supporting materials by a moisture barrier that is resistant to all expected mechanisms of deterioration in the service environment if the vertical clearance to the ground is less than 150 mm.

(8) Wood that is required by this Article to be treated to resist termites or decay shall be identified by a mark to indicate the type of preservative used and conformance to the relevant required Use Category.

9.3.3. Metal

9.3.3.1. Sheet Metal Thickness

(1) Minimum thicknesses for sheet metal material required in this Part refer to the actual minimum base metal thicknesses measured at any point of the material, and in the case of galvanized steel described in Sentence 9.3.3.2.(1), include the thickness of the galvanizing coating unless otherwise indicated.

9.3.3.2. Galvanized Sheet Steel

(1) Where sheet steel is required to be galvanized, it shall be metallic-coated with zinc or an alloy of 55% aluminium-zinc meeting the requirements of,
(a) ASTM A653 / A653M, "Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process", or
(b) ASTM A792 / A792M, "Sheet Steel, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process".

(2) Where galvanized sheet steel is intended for use in locations exposed to the weather or as a flashing material, it shall have a zinc coating not less than the G90 (Z275) coating designation or an aluminum-zinc alloy coating not less than the AZM150 coating designation, as referred to in Sentence (1).

Section 9.4. Structural Requirements

9.4.1. Structural Design Requirements and Application Limitations

9.4.1.1. General (See Appendix A.)

(1) Subject to the application limitations defined elsewhere in this Part, structural members and their connections shall,
(a) conform to requirements provided elsewhere in this Part,
(b) be designed according to good engineering practice such as provided in the CWC, "Engineering Guide for Wood Frame Construction", or
(c) be designed according to Part 4 using the loads and deflection and vibration limits specified in,
(i) this Part, or
(ii) Part 4.

(2) Where floor framing is designed in accordance with Clause (1)(b) or (c) and where supporting wall framing and fastenings or footings are designed according to Clause (1)(a), the specified *live load* on the floor shall not exceed 2.4 kPa.

(3) Location-specific information for structural design, including snow and wind loads and seismic spectral response accelerations, shall be determined according to MMAH Supplementary Standard SB-1, "Climatic and Seismic Data". (See Appendix A.)

9.4.2. Specified Loads

9.4.2.1. Application

(1) This Subsection applies to light-frame construction whose wall, floor and roof planes are generally comprised of frames of small repetitive structural members, and where,
(a) the roof and wall planes are clad, sheathed or braced on at least one side,
(b) the small repetitive structural members are spaced not more than 610 mm o.c.,
(c) the clear span of any structural member does not exceed 12.20 m,
(d) the maximum deflection of the structural roof members conforms to Article 9.4.3.1.,
(e) the maximum total roof area, notwithstanding any separation of adjoining *buildings* by *firewalls*, is 4 550 m^2, and
(f) for flat roofs, there are no significant obstructions on the roof, such as parapet walls, spaced closer than the distance calculated by,

$$D_o = 10(H_o - 0.8\,S_s / \gamma)$$

where,

D_o = minimum distance between obstructions, m,

H_o = height of the obstruction above the roof, m,

S_s = ground snow load, kPa, and

γ = unit weight of snow, kN/m^3.

(See Appendix A.)

9.4.2.2. Specified Snow Loads

(1) Except as provided in Sentences (2) and (3), specified snow loads shall be not less than those calculated using the following formula:

$$S = C_b \cdot S_s + S_r$$

where,

S = specified snow load,

C_b = basic snow load roof factor, which is 0.45 where the entire width of a roof does not exceed 4.3 m and 0.55 for all other roofs,

S_s = 1-in-50 year ground snow load in kPa, determined according to MMAH Supplementary Standard SB-1, "Climatic and Seismic Data", and

S_r = associated 1-in-50 year rain load in kPa, determined according to MMAH Supplementary Standard SB-1, "Climatic and Seismic Data".

(2) In no case shall the specified snow load be less than 1 kPa.

(3) Bow string, arch or semi-circular roof trusses having an unsupported span greater than 6 m shall be designed in conformance with the snow load requirements in Subsection 4.1.6.

9.4.2.3. Platforms Subject to Snow and Occupancy Loads

(1) Balconies, decks and other accessible exterior platforms intended for an *occupancy* and subject to snow loads shall be designed to carry the specified roof snow load or 1.9 kPa, whichever is greater, where the platform, or each segregated area of the platform, serves a single *dwelling unit*. (See Appendix A.)

9.4.2.4. Attics and Roof Spaces

(1) Ceiling joists or truss bottom chords in residential *attic or roof spaces* having limited accessibility that precludes the storage of equipment or material shall be designed for a total specified load of not less than 0.35 kPa, where the total specified load is the sum of the specified *dead load* plus the specified *live load* of the ceiling. (See Appendix A.)

9.4.3. Deflections

9.4.3.1. Deflections

(1) The maximum deflection of structural members shall conform to Table 9.4.3.1.

(2) *Dead loads* need not be considered in computing deflections referred to in Sentence (1).

Table 9.4.3.1.
Maximum Deflections
Forming Part of Sentence 9.4.3.1.(1)

Structural Members	Type of Ceiling Supported	Max. Allowable Deflection as an Expressed Ratio of the Clear Span
Roof rafters, roof joists and roof beams	No ceiling	1/180
	Other than plaster or gypsum board	1/240
	Plaster or gypsum board	1/360
Ceiling joists	Other than plaster or gypsum board	1/240
	Plaster or gypsum board	1/360
Floor beams, floor joists and floor decking	All cases	1/360
Beams, joists and decking for balconies, decks and other accessible exterior platforms	Serving a single dwelling unit	1/240
	Other	1/360
Column 1	2	3

9.4.4. Foundation Conditions

9.4.4.1. Allowable Bearing Pressures

(1) Footing sizes for *shallow foundations* shall be,
(a) determined in accordance with Section 9.15., or
(b) designed in accordance with Section 4.2. using,
  (i) the maximum *allowable bearing pressures* in Table 9.4.4.1., or
  (ii) *allowable bearing pressures* determined from *subsurface investigation*.

Table 9.4.4.1.
Allowable Bearing Pressure for Soil or Rock[1]
Forming Part of Sentence 9.4.4.1.(1)

Type and Condition of Soil or Rock	Maximum Allowable Bearing Pressure, kPa
Dense or compact sand or gravel	150
Loose sand or gravel	50
Dense or compact silt	100
Stiff clay	150
Firm clay	75
Soft clay	40
Till	200
Clay shale	300
Sound rock	500
Column 1	2

Notes to Table 9.4.4.1.:
(1) See Appendix A.

(2) The design procedures described in Section 4.2. are permitted to be used in lieu of the design procedures in this Subsection.

(3) The design procedures described in Section 4.2. shall be used where,
(a) *deep foundations* are used,
(b) the footing size falls outside the scope of this Section, or
(c) the *foundation* is constructed on peat, filled ground or on sensitive clays as described in Article 9.15.1.1.

9.4.4.2. Foundation Capacity in Weaker Soil and Rock

(1) Where a *soil* or *rock* within a distance equal to twice the footing width below the *bearing surface* has a lower *allowable bearing pressure* than that at the *bearing surface* as shown in Article 9.4.4.1., the design capacity of the *foundation* shall not be greater than would cause the weakest *soil* or *rock* to be stressed beyond its *allowable bearing pressure*.

(2) In calculating subsurface pressures referred to in Sentence (1), the loads from the footings shall be assumed to be distributed uniformly over a horizontal plane within a frustum extending downward from the footing at an angle of 60° to the horizontal.

9.4.4.3. High Water Table

(1) Where a *foundation* bears on gravel, sand or silt, and the water table is within a distance below the *bearing surface* equal to the width of the *foundation*, the *allowable bearing pressure* shall be 50% of that determined in Article 9.4.4.1.

9.4.4.4. Soil Movement

(1) Where a *foundation* is located in an area where *soil* movement caused by changes in *soil* moisture content, freezing, or chemical-microbiological oxidation is known to occur to the extent that it will damage a *building*, measures shall be taken to preclude such movement or to reduce the effects on the *building* so that the *building's* stability and the performance of assemblies will not be adversely affected. (See Appendix A.)

9.4.4.6. Walls Supporting Drained Earth (See Appendix A.)

(1) Except where constructed in accordance with Section 9.15., walls supporting drained earth shall be designed,
(a) for a pressure equivalent to that exerted by a fluid with a density of not less than 480 kg/m^3 and a depth equal to that of the retained earth, or
(b) in accordance with Section 4.2. so as to be able to resist the loads and effects described in Article 4.1.2.1.

(2) Walls supporting other than drained earth shall be designed,
(a) for the pressure described in Clause (1)(a) plus the fluid pressure of the surcharge, or
(b) in accordance with Section 4.2. so as to be able to resist the loads and effects described in Article 4.1.2.1.

Section 9.5. Design of Areas, Spaces and Doorways

9.5.1. General

9.5.1.1. Application

(1) Except as otherwise specified in this Part, this Section applies only to *dwelling units* that are intended for use on a continuing or year-round basis as the principal residence of the occupant.

9.5.1.2. Method of Measurement

(1) Except as otherwise specified in this Part, the areas, dimensions and heights of rooms or spaces shall be measured between finished wall surfaces and between finished floor and ceiling surfaces.

9.5.1.3. Floor Areas

(1) Minimum floor areas specified in this Section do not include closets or built-in bedroom cabinets unless otherwise indicated.

9.5.1.4. Combination Rooms (See Appendix A.)

(1) Two or more areas may be considered as a combination room if the opening between the areas occupies the larger of 3 m^2 or 40% or more of the wall measured on the side of the dependent area.

(2) Where the dependent area is a bedroom, direct passage shall be provided between the two areas.

(3) The opening required in Sentence (1) shall not contain doors or windows.

9.5.1.5. Lesser Areas and Dimensions

(1) Areas of rooms and spaces are permitted to be less than required in this Section provided it can be shown that the rooms and spaces are adequate for their intended use, such as by the provision of built-in furniture to compensate for reduced sizes.

9.5.2. Barrier-Free Design

9.5.2.3. Stud Wall Reinforcement

(1) If wood wall studs or sheet steel wall studs enclose the main bathroom in a *dwelling unit*, reinforcement shall be installed to permit the future installation of the following:
(a) for a water closet, a grab bar described in Clauses 3.8.3.8.(3)(a) and a grab bar described in Clause 3.8.3.8.(3)(c),
(b) for a shower, a grab bar described in Clause 3.8.3.13.(2)(f), and
(c) for a bathtub, a grab bar described in Clause 3.8.3.13.(4)(c).
(See Appendix A.)

3.8.3. Design Standards

3.8.3.8. Water Closet Stalls

(3) Where a water closet is located in accordance with Clause (2)(a),
(a) a grab bar conforming to Sentences (5) and (7) shall be provided on the side wall referred to in Subclause (2)(a)(i), and
(c) a grab bar conforming to Sentences (6) and (7) shall be provided on the wall behind the water closet.

(5) A grab bar described in Clause (3)(a) shall,
(a) be continuous L-shaped with 760 mm long horizontal and vertical components, and
(b) be wall mounted with the horizontal component 750 mm above the finished floor and the vertical component 150 mm in front of the water closet.
(See Appendix A.)

(6) A grab bar described in Clause (3)(c) or (4)(b) shall,
(a) be at least 600 mm in length, and
(b) be wall mounted horizontally from 840 mm to 920 mm above the finished floor and, where the water closet has a water tank, be wall mounted 150 mm above the tank.

(7) A grab bar described in Clause (3)(a) or (c) or (4)(b) shall,
(a) be installed to resist a load of at least 1.3 kN applied vertically or horizontally,
(b) be not less than 35 mm and not more than 40 mm in diameter,
(c) have a clearance of 50 mm from the wall, and
(d) have a slip-resistant surface.
(See Appendix A.)

3.8.3.13. Showers and Bathtub

(2) A *barrier-free* shower required by Sentence (1) shall,
(f) have a wall mounted continuous L-shaped grab bar conforming to Sentence 3.8.3.8.(7) and located between the shower head and the controls, with the horizontal component of the grab bar mounted not more than 850 mm above the finished floor, (See Appendix A.)

(4) Individual bathtubs that are provided for the use of patients or residents in *buildings* of Group B, Division 2 or 3 *occupancy* shall have,
(c) unless the bathtub is free-standing, a continuous L-shaped grab bar conforming to Sentence 3.8.3.8.(7) with 900 mm long horizontal and vertical components mounted with,
  (i) the horizontal component located not less than 150 mm and not more than 200 mm above and parallel to the rim of the bathtub, and
  (ii) the vertical component located not less than 300 mm and not more than 450 mm from the control end of the bathtub

9.5.3. Ceiling Heights

9.5.3.1. Ceiling Heights of Rooms or Spaces

(1) The ceiling heights of rooms or spaces in *residential occupancies* and *live/work units* shall conform to Table 9.5.3.1.

(2) Areas in rooms or spaces over which ceiling height is not less than the minimum specified in Table 9.5.3.1. shall be contiguous with the entry or entries to those rooms or spaces.

Table 9.5.3.1.
Room Ceiling Heights
Forming Part of Sentences 9.5.3.1.(1) and (2)

Room or Space	Minimum Heights[1]
Living room or space, dining room or space, kitchen or kitchen space	2 300 mm over at least 75% of the required floor area with a clear height of 2 100 mm at any point over the required area
Bedroom or bedroom space	2 300 mm over at least 50% of the required area or 2 100 mm over all of the required floor area. Any part of the floor having a clear height of less than 1 400 mm shall not be considered in computing the required floor area
Basement space	2 100 mm over at least 75% of the basement area except that under beams and ducts the clearance is permitted to be reduced to 1 950 mm
Bathroom, water closet room or laundry area above grade	2 100 mm in any area where a person would normally be in a standing position
Passage, hall or main entrance vestibule and finished rooms not specifically mentioned above	2 100 mm
Column 1	2

Notes to Table 9.5.3.1.:
(1) Area of the space shall be measured at floor level.

9.5.3.2. Mezzanines

(1) The ceiling height above and below a *mezzanine* floor assembly in all *occupancies* shall be not less than 2 100 mm.

9.5.3.3. Storage Garages

(1) The clear height in a *storage garage* shall be not less than 2 000 mm.

9.5.4. Living Rooms or Spaces Within Dwelling Units

9.5.4.1. Areas of Living Rooms and Spaces

(1) Living areas within *dwelling units*, either as separate rooms or in combination with other spaces, shall have an area not less than 13.5 m^2.

(2) Where the area of a living space is combined with a kitchen and dining area, the living area alone in a *dwelling unit* that contains sleeping accommodation for not more than two persons shall be not less than 11 m^2.

9.5.5. Dining Rooms or Spaces Within Dwelling Units

9.5.5.1. Area of Dining Rooms or Spaces

(1) A dining space in combination with other space shall have an area of not less than 3.25 m^2.

(2) Dining rooms not combined with other space shall have a minimum area of 7 m^2.

9.5.6. Kitchens Within Dwelling Units

9.5.6.1. Kitchen Areas

(1) Kitchen areas within *dwelling units* either separate from or in combination with other spaces, shall have an area of not less than 4.2 m^2 including the area occupied by the base cabinets, except that in *dwelling units* containing sleeping accommodation for not more than two persons, the minimum area shall be 3.7 m^2.

9.5.7. Bedrooms or Spaces in Dwelling Units and Dormitories

9.5.7.1. Areas of Bedrooms

(1) Except as provided in Articles 9.5.7.2. and 9.5.7.3., bedrooms in *dwelling units* shall have an area not less than 7 m^2 where built-in cabinets are not provided and not less than 6 m^2 where built-in cabinets are provided.

9.5.7.2. Areas of Master Bedrooms

(1) Except as provided in Article 9.5.7.3., at least one bedroom in every *dwelling unit* shall have an area of not less than 9.8 m^2 where built-in cabinets are not provided and not less than 8.8 m^2 where built-in cabinets are provided.

9.5.7.3. Areas of Combination Bedrooms

(1) Bedroom spaces in combination with other spaces in *dwelling units* shall have an area not less than 4.2 m^2.

9.5.8. Combined Spaces

9.5.8.1. Combined Living, Dining, Bedroom and Kitchen Spaces

(1) Despite Subsections 9.5.4. to 9.5.7., where living, dining, bedroom and kitchen spaces are combined in a *dwelling unit* that contains sleeping accommodation for not more than two persons, the area of the combined spaces shall be not less than 13.5 m^2.

9.5.9. Bathrooms and Water Closet Rooms

9.5.9.1. Space to Accommodate Fixtures

(1) In every *dwelling unit* an enclosed space of sufficient size shall be provided to accommodate a water closet, lavatory and bathtub or shower stall.

9.5.9.2. Doors to Rooms Containing Water Closets

(1) A door shall be provided to each room containing a water closet within a *dwelling unit*.

9.5.10. Hallways

9.5.10.1. Hallway Width

(1) The unobstructed width of a hallway within a *dwelling unit* shall be not less than 860 mm, except that the hallway width is permitted to be 710 mm, where,

(a) there are only bedrooms and bathrooms at the end of the hallway furthest from the living area, and

(b) a second *exit* is provided,

  (i) in the hallway near the end furthest from the living area, or

  (ii) in each bedroom served by the hallway.

9.5.11. Doorway Sizes

9.5.11.1. Doorway Opening Sizes

(1) Except as provided in Articles 9.5.11.3., 9.9.6.2. and 9.9.6.3., doorway openings within *dwelling units* shall be designed to accommodate at least the door sizes in Table 9.5.11.1. for swing-type doors or folding doors.

Table 9.5.11.1.
Minimum Door Sizes
Forming Part of Sentence 9.5.11.1.(1)

At Entrance to:	Minimum Width, mm	Minimum Height, mm
Dwelling unit (required entrance) Vestibule or entrance hall	810	1 980
Stairs to a floor level that contains a finished space All doors in at least one line of passage from the exterior to the basement Utility rooms	810	1 980
Walk-in closet	610	1 980
Bathroom, water closet room, shower room(1)	610	1 980
Rooms located off hallways that are permitted to be 710 mm wide	610	1 980
Rooms not mentioned above, exterior balconies	760	1 980
Column 1	2	3

Notes to Table 9.5.11.1.:
(1) See Article 9.5.11.3.

Section 9.6. Glass

9.6.1. General

9.6.1.1. Application

(1) This Section applies to,
(a) glass in,
   (i) interior windows and interior doors and their sidelights,
   (ii) clothes closets,
   (iii) site-built exterior windows, doors and skylights,
   (iv) shower or bathtub enclosures,
   (v) glazed panels and *partitions*, and
(b) the protection of glass.

9.6.1.2. Material Standards for Glass

(1) Glass shall conform to,
(a) CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass,"
(b) CAN/CGSB-12.2-M, "Flat, Clear Sheet Glass",
(c) CAN/CGSB-12.3-M, "Flat, Clear Float Glass",
(d) CAN/CGSB-12.4-M, "Heat-Absorbing Glass,"
(e) CAN/CGSB-12.8, "Insulating Glass Units",
(f) CAN/CGSB-12.10-M, "Glass, Light and Heat Reflecting",

(g) CAN/CGSB-12.11-M, "Wired Safety Glass", or
(h) ASTM E2190, "Insulating Glass Unit Performance and Evaluation".

(2) Mirrored glass doors are permitted to be used only at the entrance to clothes closets and shall conform to the requirements of CAN/CGSB-82.6-M, "Doors, Mirrored Glass, Sliding or Folding, Wardrobe". (See Appendix A.)

(3) Mirrored glass doors reinforced with a film backing shall meet the impact resistance requirements specified in CAN/CGSB-12.5-M, "Mirrors, Silvered".

9.6.1.3. Structural Sufficiency of Glass

(1) Glass shall be designed in conformance with CAN/CGSB-12.20-M, "Structural Design of Glass for Buildings". (See Appendix A.)

(2) The maximum area of individual panes of glass for doors shall conform to Table 9.6.1.3.

Table 9.6.1.3.
Maximum Glass Area for Doors(2)
Forming Part of Sentence 9.6.1.3.(2)

Glass Thickness, mm	Maximum Glass Area, m^2						
	Type of Glass						
	Annealed	Annealed Multiple-Glazed Factory-Sealed Units	Laminated	Wired	Heat Strengthened	Fully Tempered	Fully Tempered Multiple-Glazed Factory-Sealed Units
3	0.50	0.70	(1)	(1)	1.00	1.00	2.00
4	1.00	1.50	(1)	(1)	1.50	4.00	4.00
5	1.50	1.50	(1)	(1)	1.50	No limit	No limit
6	1.50	1.50	1.20	1.00	1.50	No limit	No limit
Column 1	2	3	4	5	6	7	8

Notes to Table 9.6.1.3.:
(1) Not generally available.
(2) See Appendix A.

9.6.1.4. Types of Glass and Protection of Glass

(1) Glass sidelights greater than 500 mm wide that could be mistaken for doors, glass in storm doors and glass in sliding doors within or at every entrance to a *dwelling unit* and in public areas shall be,
(a) safety glass of the tempered or laminated type conforming to CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass", or
(b) wired glass conforming to CAN/CGSB-12.11-M, "Wired Safety Glass".

(2) Except as provided in Sentence (4), glass in entrance doors to *dwelling units* and in public areas, other than the entrance doors described in Sentence (1), shall be safety glass or wired glass of the type described in Sentence (1) where the glass area exceeds 0.5 m^2 and extends to less than 900 mm from the bottom of the door.

(6) Glass, other than safety glass, shall not be used for a shower or bathtub enclosure.

Section 9.7. Windows, Doors and Skylights

9.7.1. General

9.7.1.1. Application

(1) This Section applies to,
(a) windows, doors and skylights separating *conditioned space* from unconditioned space or the exterior, and
(b) main entrance doors.

(2) For the purpose of this Section, the term "skylight" refers to unit skylights, roof windows and tubular daylighting devices.

(3) For the purpose of this Section, the term "doors" includes glazing in doors and sidelights for doors.

9.7.2. Required Windows, Doors and Skylights

9.7.2.1. Entrance Doors

(1) A door shall be provided at each entrance to a *dwelling unit*.

(2) Main entrance doors to *dwelling units* shall be provided with,
(a) a door viewer or transparent glazing in the door, or
(b) a sidelight.

9.7.2.2. Other Requirements for Windows, Doors and Skylights

(1) Windows and skylights installed to provide required non-heating season ventilation shall conform to Article 9.32.2.1.

(2) Windows and doors installed to provide the required *means of egress* from bedrooms shall conform to Subsection 9.9.10.

(3) Windows and doors installed to provide the required access to a *building* for firefighting purposes shall conform to Subsection 9.10.20.

(4) The protection of window and door openings against persons falling through the window or door opening shall conform to Article 9.8.8.1.

(6) The location and protection of windows, doors and skylights in order to control the spread of fire shall conform to Subsection 9.10.12.

(7) Doors between *dwelling units* and attached garages shall conform to Article 9.10.13.15.

(8) The surface *flame-spread rating* for doors and skylights shall conform to Article 9.10.17.1.

9.7.2.3. Minimum Window Areas

(1) Except as required in Article 9.9.10.1. and Sentence (3), the minimum window glass area for rooms in *buildings* of *residential occupancy* or rooms that are used for sleeping shall conform to Table 9.7.2.3.

Table 9.7.2.3.
Glass Areas for Rooms of Residential Occupancy
Forming Part of Sentence 9.7.2.3.(1)

Location	Minimum Unobstructed Glass Area With No Electric Lighting	Minimum Unobstructed Glass Area With Electric Lighting
Laundry, basement recreation room, unfinished basement	4% of area served	Windows not required
Water closet room	0.37 m^2	Windows not required
Kitchen, kitchen space, kitchen alcove	10% of area served	Windows not required
Living rooms and dining rooms	10% of area served	10% of area served
Bedrooms and other finished rooms not mentioned above	5% of area served(1)	5% of area served(1)
Column 1	2	3

Notes to Table 9.7.2.3.:
(1) See Subsection 9.9.10.

(2) The unobstructed glass area of a door or skylight is considered equivalent to that of a window.

(4) Where rooms with different requirements for window glass area are combined as described in Sentence 9.5.1.4.(1), the more restrictive requirement shall govern.

9.7.3. Performance of Windows, Doors and Skylights

9.7.3.1. General Performance Criteria

(1) Except as provided in Sentences (2) to (4), windows, doors and skylights and their components separating *conditioned space* from unconditioned space or the exterior shall be designed, constructed and installed so that, when in the closed position, they,
(a) resist the ingress of precipitation into interior space,
(b) resist wind loads,
(c) control air leakage,
(d) resist the ingress of insects and vermin,
(e) where required, resist forced entry, and
(f) are easily operable, unless they are fixed units.

(2) Skylights and their components shall be designed, constructed and installed so that, when in the closed position, they resist snow loads.

(3) Main entrance doors and their components shall be designed, constructed and installed so that, when in the closed position, they,
(a) control air leakage,
(b) resist the ingress of insects and vermin,
(c) resist forced entry, and
(d) are easily operable.

(4) Storm doors, sliding doors and their components shall be designed, constructed and installed so that, when in the closed position, they,
(a) resist wind loads,
(b) control air leakage to a minimum allowable 5 m^3h/m and a maximum allowable 8.35 m^3h/m,
(c) resist the ingress of insects and vermin, and
(d) are easily operable.

(5) Compliance with the performance requirements described in Sentences (1) to (4) shall be demonstrated by,
(a) compliance with the requirements in,
  (i) Subsection 9.7.4. or 9.7.5., and
  (ii) Subsection 9.7.6., or
(b) design and construction conforming to Part 5.

9.7.3.2. Heat Transfer Performance

(1) Windows, doors and skylights described in Clause 9.7.1.1.(1)(a) and their components shall be designed, constructed and installed to,
(a) minimize surface condensation on the warm side of the component, and (See Appendix A.)
(b) ensure comfortable conditions for the occupants.

(2) Compliance with the heat transfer performance requirements described in Sentence (1) shall be demonstrated by,
(a) compliance with the requirements in Article 9.7.3.3., or
(b) design and construction conforming to Part 5.

9.7.3.3. Thermal Characteristics of Windows, Doors and Skylights

(1) Except as permitted in Sentence (2), metal frames and sash of windows, doors and skylights shall incorporate a thermal break.

(2) Windows and doors described in Sentence (1) do not require a thermal break where they are installed as,
(a) vehicular access doors,
(b) storm windows and doors, or
(c) windows and doors that are required to have a *fire-resistance rating*.

(3) Windows, doors and skylights, with or without storm doors or sash, that are installed in *buildings* where the intended use of the interior space will not result in high moisture generation shall have a maximum thermal transmittance (U-value) or minimum temperature index (I) in accordance with Table 9.7.3.3.

(4) Windows, doors and skylights, with or without storm doors or sash, that are installed in portions of *buildings* where the intended use of the interior space will result in high moisture generation shall be designed in conformance with Subsection 5.3.

Table 9.7.3.3.
Maximum U-value or Minimum Temperature Index (I) for Windows, Doors and Skylights[(1)(2)(3)]
Forming Part of Sentence 9.7.3.3.(3)

Component	2.5% January Design Temperature			
	Between -15°C and -30°C		Colder than -30°C	
	max. U-value, W/m²K	min. I	max. U-value, W/m²K	min. I
Windows and Doors	2.0	68	1.7	77
Skylights	3.0	(2)	2.7	(2)
Column 1	2	3	4	5

Notes to Table 9.7.3.3.:
(1) U-values for specific products can be determined according to measures referenced in AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights". Temperature index (I) is determined according to the physical test procedure given in CSA A440.2/A440.3, "Fenestration Energy Performance/User Guide to CSA A440.2-09, Fenestration Energy Performance".
(2) There is no appropriate test procedure available for testing the condensation resistance of sloped glazing.
(3) Where the U-value in this Table differs from the U-value provided in MMAH Supplementary Standard SB-10, "Energy Efficiency Requirements" or MMAH Supplementary Standard SB-12, "Energy Efficiency for Housing", the most restrictive U-value shall apply.

9.7.4. Manufactured Windows, Doors and Skylights

9.7.4.1. Application

(1) This Subsection applies to windows, doors and skylights that are within the scope of AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights".

9.7.4.2. General

(1) Manufactured and pre-assembled windows, doors and skylights and their installation shall conform to,
(a) AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights",
(b) CSA A440S1, "Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights",
(c) this Subsection, and
(d) the applicable requirements in Subsection 9.7.6.
(See Appendix A.)

9.7.4.3. Performance Requirements

(1) Performance grades for windows, doors and skylights shall be selected according to CSA A440S1, "Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights" so as to be appropriate for the conditions and geographic location in which the window, door or skylight will be installed.

(2) Windows, doors and skylights shall conform to the performance grades selected under Sentence (1) when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights".

(3) The minimum level of performance required for windows, doors and skylights shall be that of the Performance Class R.

(4) Exterior wood doors shall conform to CAN/CSA-O132.2 Series, "Wood Flush Doors" and shall have legibly indicated on them,
(a) the name of the manufacturer,
(b) the standard to which they were produced, and
(c) that they are of an exterior type.

9.7.5. Site-Built Windows, Doors and Skylights

9.7.5.1. Application and Compliance

(1) Materials, design, construction and installation of windows, doors and skylights that separate *conditioned space* from unconditioned space or the exterior but that are not within the scope of AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights" shall,
(a) conform to,
  (i) this Subsection or Subsection 9.7.4., and
  (ii) the applicable requirements in Subsection 9.7.6., or
(b) conform to Part 5.

(2) Glass for site-built windows, doors, sidelights for doors, and skylights shall comply with Section 9.6.

9.7.5.2. Resistance to Forced Entry for Doors

(1) Except for exterior doors to garages and to other ancillary spaces, this Article applies to,
(a) swinging entrance doors to *dwelling units*,
(b) swinging doors between *dwelling units* and attached garages or other ancillary spaces, and
(c) swinging doors that provide access directly or indirectly from a *storage garage* to a *dwelling unit*.
(See Appendix A.)

(2) Doors, frames and hardware that conform to a security level of at least Grade 10 as described in the Annex to ASTM F476, "Security of Swinging Door Assemblies", are not required to conform to Sentences (3) to (7). (See Appendix A.)

(3) Except as provided in Sentence (2), wood doors described in Sentence (1) shall,
(a) be solid core or stile-and-rail type,
(b) be not less than 45 mm thick, and
(c) if of the stile-and-rail panel type, have a panel thickness of not less than 19 mm, with a total panel area not more than half of the door area.

(4) Except as provided in Sentence (2), doors described in Sentence (1) shall be provided with,
(a) a deadbolt lock with a cylinder having no fewer than five pins, and
(b) a bolt throw not less than 25 mm long, protected with a solid or hardened free-turning ring or bevelled cylinder housing.

(5) Except as provided in Sentence (2), an inactive leaf in double doors used in locations specified in Sentence (1) shall be provided with heavy-duty bolts top and bottom having an engagement of not less than 15 mm.

(6) Except as provided in Sentence (2), hinges for doors described in Sentence (1) shall be fastened,
(a) to wood doors with wood screws not less than 25 mm long and to wood frames with wood screws such that at least two screws per hinge penetrate not less than 30 mm into solid wood, or
(b) to metal doors and metal frames with machine screws not smaller than No. 10 and not less than 10 mm long.
(See Appendix A.)

(7) Except as provided in Sentence (2), strikeplates for deadbolts described in Sentence (4) shall be fastened,
(a) to wood frames with wood screws that penetrate not less than 30 mm into solid wood, or
(b) to metal frames with machine screws not smaller than No. 8 and not less than 10 mm long.

(8) Except for storm doors or screen doors, doors described in Sentence (1) that swing outward shall be provided with hinges or pins so that the doors cannot be removed when they are in the closed position. (See Appendix A.)

(9) Solid blocking shall be provided on both sides at the lock height between the jambs for doors described in Sentence (1) and the structural framing so that the jambs will resist spreading by force.

9.7.5.3. Resistance to Forced Entry for Windows

(1) In *dwelling units*, windows, any part of which is located within 2 m of adjacent ground level, shall conform to the requirements for resistance to forced entry as described in Clause 5.3.5 of AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights". (See Appendix A.)

9.7.6. Installation

9.7.6.1. Installation of Windows, Doors and Skylights

(1) The installation of windows, doors and skylights shall conform to CAN/CSA-A440.4, "Window, Door and Skylight Installation", except that,
(a) shims used to support windows, doors and skylights are permitted to be of treated plywood, and
(b) protection from precipitation for walls incorporating windows or doors and for roofs incorporating skylights, and the interfaces of these walls with windows or doors and of roofs with skylights, shall conform to Section 9.27.

(2) The installation of manufactured and pre-assembled windows, doors and skylights and the field assembly of manufactured window and door combination units shall conform to the manufacturer's instructions.

(3) Windows, doors and skylights shall be sealed to air barriers and *vapour barriers*.

9.7.6.2. Sealants, Trim and Flashing

(1) The sealing compound used to seal the glass component of an insulating glazing unit to the sash component shall be compatible with the sealing compound used to edge seal the glass component.

(2) Flashing used to protect openings shall conform to Articles 9.27.3.7. and 9.27.3.8.

(3) Sealants shall be applied between window frames or trim and the exterior cladding or masonry in conformance with Subsection 9.27.4.

(4) All unfinished portions of the frame and other components of aluminum windows, doors or skylights in contact with the edges of masonry, concrete, stucco or plaster shall be protected with an alkali-resistant coating.

Section 9.8. Stairs, Ramps, Handrails and Guards

9.8.1. Application

9.8.1.1. General

(1) This Section applies to the design and construction of interior and exterior stairs, steps, ramps, handrails and *guards*.

9.8.1.2. Stairs, Ramps, Landings, Handrails and Guards in Garages

(1) Except as provided in Sentence 9.8.6.2. (3), stairs, ramps, landings, handrails and *guards* in a garage that serves a single *dwelling unit* shall conform to the requirements for stairs, ramps, landings, handrails and *guards* within a *dwelling unit*.

9.8.1.3. Exit Stairs, Ramps and Landings

(1) Where a stair, ramp or landing forms part of an *exit*, the appropriate requirements in Sections 9.9. and 9.10. shall also apply.

9.8.2. Stair Dimensions

9.8.2.1. Stair Width

(1) Except as provided in Sentence (2), required *exit* stairs and public stairs serving *buildings* of *residential occupancy* shall have a width, measured between wall faces or *guards*, of not less than 900 mm.

(2) At least one stair between each floor level within a *dwelling unit*, and exterior stairs and required *exit* stairs serving a single *dwelling unit*, shall have a width of not less than 860 mm.

9.8.2.2. Height Over Stairs

(1) The clear height over stairs shall be,
(a) measured vertically, over the clear width of the stair, from a straight line tangent to the tread and landing nosings to the lowest point above, and
(b) not less than,
  (i) 1 950 mm for stairs serving a single *dwelling unit*, and
  (ii) 2 050 mm for stairs not serving a single *dwelling unit*.

9.8.3. Stair Configurations

9.8.3.1. Straight and Curved Runs in Stairs

(1) Except as provided in Sentence (2), stairs shall consist of,
(a) straight-runs, or
(b) curved-runs.

(2) Stairs within *dwelling units* shall consist of,
(a) straight-runs,
(b) curved-runs,
(c) straight-runs with winders, or
(d) straight-runs with curved-runs.

9.8.3.3. Maximum Height of Stairs

(1) The vertical height between any landings shall not exceed 3.7 m.

9.8.4. Step Dimensions (See Appendix A.)

9.8.4.1. Dimensions for Risers

(1) The rise, which is measured as the vertical nosing-to-nosing distance, shall conform to Table 9.8.4.1.

Table 9.8.4.1.
Rise, Run and Tread Depth for Rectangular Treads
Forming Part of Sentences 9.8.4.1.(1) and 9.8.4.2.(1)

Stair Type	All Steps		Rectangular Treads			
	Rise, mm		Run, mm		Tread Depth, mm	
	max.	min.	max.	min.	max.	min.
Service and mezzanines in live/work units[1]	no limit	125	355	no limit	355	no limit
Private[2]	200	125	355	210	355	235
Public[3]	180	125	no limit	280	no limit	280
Column 1	2	3	4	5	6	7

Notes to Table 9.8.4.1.:

(2) Private stairs are interior stairs within dwelling units and exterior stairs serving a single dwelling unit or a garage that serves a single dwelling unit.

9.8.4.2. Dimensions for Rectangular Runs and Treads

(1) The run, which is measured as the horizontal nosing-to-nosing distance, and the tread depth of rectangular treads shall conform to Table 9.8.4.1.

(2) The depth of a rectangular tread shall be not less than its run and not more than its run plus 25 mm.

9.8.4.3. Dimensions for Angled Treads

(1) Angled treads in required *exit* stairs shall conform to the requirements in Article 3.4.6.9.

(2) Except as provided in Article 9.8.4.5., angled treads in other than required *exit* stairs shall have an average run, which is measured as the horizontal nosing-to-nosing distance, of not less than 200 mm and a minimum run of 150 mm.

(3) The depth of an angled tread shall be not less than its run, measured as the horizontal nosing-to-nosing distance, at any point and not more than its run at any point plus 25 mm.

9.8.4.4. Uniformity and Tolerances for Risers and Treads

(1) Except as provided in Sentence (2), risers shall be of uniform height in any one flight with a maximum tolerance of,
(a) 5 mm between adjacent treads or landings, and
(b) 10 mm between the tallest and shortest risers in a flight.

(2) Except for required *exit* stairs, where the top or bottom riser in a stair adjoins a sloping finished walking surface such as a garage floor, driveway or sidewalk, the height of the riser across the stair shall vary by not more than 1 in 12.

(3) Treads shall have uniform run with a maximum tolerance of,
(a) 5 mm between adjacent treads, and
(b) 10 mm between the deepest and shallowest treads in a flight.

(4) Where angled treads or winders are incorporated into a stair, the treads in all sets of angled treads or winders within a flight shall turn in the same direction.

(5) The slope of treads shall not exceed 1 in 50.

9.8.4.5. Winders (See Appendix A.)

(1) Stairs within *dwelling units* are permitted to contain winders that converge to a centre point provided,
(a) the winders turn through an angle of not more than 90°,
(b) individual treads turn through an angle of not less than 30° or not more than 45°, and
(c) adjacent winders turn through the same angle.

(2) Where more than one set of winders described in Sentence (1) is provided in a single stairway between adjacent floor levels, such winders shall be separated in plan by at least 1 200 mm.

9.8.4.6. Leading Edges of Treads

(1) Leading edges of treads that are bevelled or rounded shall,
(a) not reduce the required tread depth by more than 15 mm, and
(b) not, in any case, exceed 25 mm horizontally.
(See Appendix A.)

9.8.5. Ramps

9.8.5.1. Application

(1) This Subsection applies to pedestrian ramps except ramps in a *barrier-free* path of travel.

9.8.5.2. Ramp Width

(2) A ramp serving a single *dwelling unit* shall have a width of not less than 860 mm.

9.8.5.3. Height Over Ramps

(1) The clear height over ramps shall be not less than,
(a) 1 950 mm for ramps serving a single *dwelling unit*, and
(b) 2 050 mm for ramps not serving a single *dwelling unit*.

9.8.5.4. Slope

(1) The slope of ramps shall be not more than,
(a) 1 in 10 for exterior ramps, and
(b) 1 in 10 for interior ramps serving *residential occupancies*

9.8.5.5. Maximum Rise

(1) Where the slope of the ramp is greater than 1 in 12, the maximum rise between floors or landings shall be 1 500 mm.

9.8.6. Landings

9.8.6.1. Application

(1) This Subsection applies to landings, except landings for ramps in a *barrier-free* path of travel.

(3) Finished floors, and ground surfaces with a slope not exceeding 1 in 50, at the top and bottom of stairs or ramps shall be considered as landings.

9.8.6.2. Required Landings

(1) Except as provided in Sentences (2) to (4) and Sentence 9.9.6.6.(2), a landing shall be provided,
(a) at the top and bottom of each flight of interior and exterior stairs, including stairs in garages,
(b) at the top and bottom of every ramp with a slope greater than 1 in 50, and
(c) where a doorway opens onto a stair or ramp.

(2) Where a door at the top of a stair in a *dwelling unit* swings away from the stair, no landing is required between the doorway and the stair.

(3) A landing may be omitted at the top of an exterior stair serving a garage or a secondary entrance to a single *dwelling unit*, including an entrance from an attached garage, provided,
(a) the stair does not contain more than three risers,
(b) except as provided in Clause (c), the door is a sliding door or swings away from the stair, and
(c) where a storm or screen door is provided, it may swing over the stair if it is equipped with hardware to hold it open.

(4) A landing may be omitted at the bottom of an exterior stair or ramp provided there is no obstruction, such as a gate or door, within the lesser of the width of the stair or ramp, or,
(a) 900 mm for stairs or ramps serving a single *dwelling unit*

9.8.6.3. Dimensions of Landings

(1) Except as provided in Sentences (3) to (6), the width and length of landings shall comply with Table 9.8.6.3. (See Appendix A.)

Table 9.8.6.3.
Dimensions of Landings
Forming Part of Sentence 9.8.6.3.(1)

Application	Landing Configuration	Minimum Width, mm	Length, mm
Stairs and ramps serving a single dwelling unit	In straight-run stair or ramp, or landing turning through less than 30°, within a dwelling unit	Width of stair or ramp	Not less than 860
	In straight-run exterior stair or ramp, or exterior landing turning through less than 30°	Width of stair or ramp	Not less than 900
	Landing turning through an angle of 30° or more, but less than 90°	Width of stair or ramp measured at right angle to path of travel	(a) Not less than 230 measured at the inside edge of the landing, and (b) Not less than 370 measured 230 from the inside edge of landing or handrail
	Landing turning through not less than 90°	Width of stair or ramp measured at right angle to path of travel	Not less than width of stair or ramp landing
Column 1	2	3	4

(3) Where stairs or ramps of different widths adjoin a single landing, the minimum width of the landing shall be,
(a) not less than the greater required stair or ramp width, where one or more of the stair or ramp widths do not exceed their respective required widths, or
(b) not less than the lesser actual stair or ramp width, where all of the widths of the stairs or ramps exceed their respective required widths.

(4) Where a door swings toward a stair, the full arc of the swing shall be over the landing.

(5) The slope of landings shall not exceed 1 in 50.

(6) Where a doorway or stairway opens onto the side of a ramp, the landing shall extend for a distance of not less than 300 mm on either side of the doorway or stairway, except on a side abutting an end wall.

9.8.6.4. Height Over Landings

(1) The clear height over landings shall be not less than,
(a) 1 950 mm for landings serving a single *dwelling unit,* and
(b) 2 050 mm for landings not serving a single *dwelling unit.*

9.8.7. Handrails

9.8.7.1. Required Handrails

(1) Except as provided in Sentences (2) to (4), a handrail shall be installed on stairs and ramps in conformance with Table 9.8.7.1.

Table 9.8.7.1.
Handrails for Stairs and Ramps
Forming Part of Sentence 9.8.7.1.(1)

Location of Stair or Ramp	Handrails Serving Stairs			Handrails Serving Ramps	
	Stairs < 1 100 mm Wide		Stairs ≥ 1 100 mm Wide	Ramps < 1 100 mm Wide	Ramps ≥ 1 100 mm Wide
	Straight	Curved	All	Straight or Curved	All
	Number of Sides Required to have a Handrail				
Within a dwelling unit	1	1	1	1	2
All other locations	1	2	2	2	2
Column 1	2	3	4	5	6

(3) A handrail is not required for stairs and ramps serving a single *dwelling unit*, where,
(a) interior stairs have not more than two risers,
(b) exterior stairs have not more than three risers, or
(c) ramps rise not more than 400 mm.

(4) Only one handrail is required on exterior stairs having more than three risers, provided such stairs serve a single *dwelling unit.*

9.8.7.2. Continuity of Handrails (See Appendix A.)

(2) For stairs or ramps serving a single *dwelling unit*, at least one required handrail shall be continuous throughout the length of the stair or ramp, except where interrupted by,
(a) doorways,
(b) landings, or
(c) newel posts at changes in direction.

9.8.7.4. Height of Handrails (See Appendix A.)

(1) The height of handrails on stairs and ramps shall be measured vertically from the top of the handrail to,
(a) a straight line drawn tangent to the tread nosings of the stair served by the handrail, or
(b) the surface of the ramp, floor or landing served by the handrail.

(2) Except as provided in Sentences (3) and (4), the height of handrails on stairs and ramps shall be,
(a) not less than 865 mm, and
(b) not more than 965 mm.

(3) Where *guards* are required, handrails required on landings shall be not more than 1 070 mm in height.

(4) Handrails installed in addition to required handrails need not comply with Sentence (2).

9.8.7.5. Ergonomic Design

(1) A clearance of not less than 50 mm shall be provided between a handrail and any surface behind it.

(2) All handrails shall be constructed so as to be continually graspable along their entire length with no obstruction on or above them to break a handhold, except where the handrail is interrupted by newels at changes in direction. (See Appendix A.)

9.8.7.6. Projections into Stairs and Ramps

(1) Handrails and projections below handrails, including handrail supports and stair stringers, shall not project more than 100 mm into the required width of a stair or ramp.

9.8.7.7. Design and Attachment of Handrails (See Appendix A.)

(1) Handrails and any *building* element that could be used as a handrail shall be designed and attached in such a manner as to resist,
(a) a concentrated load at any point of not less than 0.9 kN, and
(b) for handrails other than those serving a single *dwelling unit*, a uniformly distributed load of 0.7 kN/m.

(2) Where a handrail serving a single *dwelling unit* is attached to wood studs or blocking, the attachment shall be deemed to comply with Sentence (1), where,
(a) the attachment points are spaced not more than 1.2 m apart,
(b) the first attachment point at either end is located not more than 300 mm from the end of the handrail, and
(c) the fasteners consist of no fewer than two wood screws at each point, penetrating not less than 32 mm into solid wood.

9.8.8. Guards

9.8.8.1. Required Guards (See Appendix A.)

(1) Except as provided in Sentences (2) and (3), every surface to which access is provided for other than maintenance purposes, including but not limited to flights of steps and ramps, exterior landings, porches, balconies, *mezzanines*, galleries and raised walkways, shall be protected by a *guard* on each side that is not protected by a wall for the length, where,
(a) there is a difference in elevation of more than 600 mm between the walking surface and the adjacent surface, or
(b) the adjacent surface within 1.2 m from the walking surface has a slope of more than 1 in 2.

(3) When an interior stair has more than two risers or an interior ramp rises more than 400 mm, the sides of the stair or ramp and the landing or floor level around the stairwell or ramp shall be protected by a *guard* on each side that is not protected by a wall.

(4) Doors in *buildings* of *residential occupancy*, where the finished floor on one side of the door is more than 600 mm above the floor or other surface or ground level on the other side of the door, shall be protected by,
(a) a *guard* in accordance with this Subsection, or
(b) a mechanism capable of controlling the free swinging or sliding of the door so as to limit any clear unobstructed opening to not more than 100 mm.

(8) In *dwelling units*, glazing installed over stairs, ramps and landings that extends to less than 900 mm above the surface of the treads, ramp or landing shall be,
(a) protected by *guards* in accordance with this Subsection, or
(b) non-openable and designed to withstand the specified lateral loads for *guards* as provided in Article 4.1.5.14.

9.8.8.2. Loads on Guards (See Appendix A.)

(1) Except as provided in Sentence (5), *guards* shall be designed to resist the specified loads prescribed in Table 9.8.8.2.

Table 9.8.8.2.
Specified Loads for Guards
Forming Part of Sentence 9.8.8.2.(1)

Location of Guard	Minimum Specified Loads		
	Horizontal Load Applied Inward or Outward at any Point at the Minimum Required Height of the Guard	Horizontal Load Applied Inward or Outward on Elements Within the Guard, Including Solid Panels and Pickets	Evenly Distributed Vertical Load Applied at the Top of the Guard
Guards within dwelling units and exterior guards serving not more than 2 dwelling units	0.5 kN/m or concentrated load of 1.0 kN applied at any point(1)	0.5 kN applied over a maximum width of 300 mm and a height of 300 mm(2)	1.5 kN/m
Column 1	2	3	4

Notes to Table 9.8.8.2.:
(1) The load that creates the most critical condition shall apply.
(2) See Sentence (2).

(2) Where the width and spacing of balusters in *guards* within *dwelling units* and in exterior *guards* serving not more than two *dwelling units* is such that three balusters can be engaged by a load imposed over a 300 mm width, the load shall be imposed so as to engage three balusters.

(3) None of the specified loads prescribed in Table 9.8.8.2. need be considered to act simultaneously.

(4) For *guards* within *dwelling units* and for exterior *guards* serving not more than 2 *dwelling units*, Table 9.8.8.2. need not apply where the *guard* construction has been demonstrated to provide effective performance.

(5) *Guards* constructed in accordance with the requirements in MMAH Supplementary Standard SB-7, "Guards for Housing and Small Buildings" shall be deemed to satisfy the requirements of Sentence (1).

9.8.8.3. Height of Guards (See Appendix A.)

(1) Except as provided in Sentences (2) to (6), all *guards* shall be not less than 1 070 mm high.

(2) All *guards* within *dwelling units* shall be not less than 900 mm high.

(3) Exterior *guards* serving not more than one *dwelling unit* shall be not less than 900 mm high where the walking surface served by the *guard* is not more than 1 800 mm above the finished ground level.

(4) *Guards* for flights of steps, except in required *exit* stairs, shall be not less than 900 mm high.

(5) Except as provided in Sentence (6), the height of *guards* shall be not less than,
(a) 920 mm for required *exit* stairs, and
(b) 1 070 mm around landings.

(6) The height of *guards* for exterior stairs and landings more than 10 m above adjacent ground level shall be not less than 1 500 mm.

(7) The height of *guards* for stairs and landings shall be measured vertically from the top of the *guard* to,
(a) a straight line drawn tangent to the tread nosings of the stair, or
(b) the surface of the landing.

9.8.8.5. Openings in Guards

(1) Except as provided in Sentence (2), openings through any *guard* that is required by Article 9.8.8.1. shall be of a size that will prevent the passage of a spherical object having a diameter of 100 mm unless it can be shown that the location and size of openings that exceed this limit do not represent a hazard. (See Appendix A.)

(3) Unless it can be shown that the location and size of openings that do not comply with the following limits do not represent a hazard, openings through any *guard* that is not required by Article 9.8.8.1. and that serves a *building* of other than *industrial occupancy*, shall be of a size that,
(a) will prevent the passage of a spherical object having a diameter of 100 mm, or
(b) will permit the passage of a spherical object having a diameter of 200 mm.
(See Appendix A.)

9.8.8.6. Guards Designed Not to Facilitate Climbing

(1) *Guards* required by Article 9.8.8.1., except those in *industrial occupancies* and where it can be shown that the location and size of openings do not represent a hazard, shall be designed so that no member, attachment or opening located between 140 mm and 900 mm above the floor or walking surface protected by the *guard* will facilitate climbing. (See Appendix A.)

9.8.8.7. Glass in Guards

(1) Glass in *guards* shall be,
(a) safety glass of the laminated or tempered type conforming to CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass", or
(b) wired glass conforming to CAN/CGSB-12.11-M, "Wired Safety Glass".

9.8.9. Construction

9.8.9.1. Loads on Stairs and Ramps

(1) Except as required in Articles 9.8.9 4. and 9.8.9.5., stairs and ramps shall be designed for strength and rigidity under uniform loading criteria to support specified loads of,
(a) 1.9 kPa for stairs and ramps serving a single *dwelling unit*

9.8.9.2. Exterior Concrete Stairs

(1) Exterior concrete stairs with more than two risers and two treads shall be,
(a) supported on unit masonry or concrete walls or piers not less than 150 mm in cross-section, or
(b) cantilevered from the main *foundation* wall.

(2) Stairs described in Sentence (1), when cantilevered from the *foundation* wall, shall be constructed and installed in conformance with Subsection 9.8.10.

(3) The depth below ground level for *foundations* for exterior steps shall conform to the requirements in Section 9.12.

9.8.9.3. Exterior Wood Steps

(1) Exterior wood steps shall not be in direct contact with the ground unless suitably treated with a wood preservative.

9.8.9.4. Wooden Stair Stringers

(1) Wooden stair stringers shall,
(a) have a minimum effective depth of 90 mm, measured perpendicularly to the bottom of the stringer at the point of minimum cross-section, and an overall depth of not less than 235 mm,
(b) be supported and secured top and bottom,
(c) be not less than 25 mm actual thickness if supported along their length and 38 mm actual thickness if unsupported along their length, and
(d) except as permitted in Sentence (2), be spaced not more than 900 mm o.c. for stairs serving not more than one *dwelling unit*, and 600 mm o.c. in other stairs.

(2) For stairs serving not more than one *dwelling unit*, where risers support the front portion of the tread, the space between stringers shall be not more than 1 200 mm.

9.8.9.5. Treads

(1) Stair treads of lumber, plywood or O-2 grade OSB within *dwelling units* shall be not less than 25 mm actual thickness, except that if open risers are used and the distance between stringers exceeds 750 mm, the treads shall be not less than 38 mm actual thickness.

(2) Stair treads of plywood or OSB, that are not continuously supported by the riser shall have their face grain or direction of face orientation at right angles to the stringers.

9.8.9.6. Finish for Treads, Landings and Ramps

(1) Except as required by Sentence (5), the finish for treads, landings and ramps shall be,
(a) wear-resistant,
(b) slip-resistant, and
(c) smooth, even and free from open defects.

(2) The finish for treads, landings and ramps in *dwelling units*, including those from an attached garage serving a single *dwelling unit*, shall be deemed to comply with Sentence (1) where these treads, landings or ramps are finished with,
(a) hardwood,
(b) vertical grain softwood,
(c) resilient flooring,
(d) low-pile carpet,
(e) mat finish ceramic tile,
(f) concrete, or
(g) for stairs to unfinished *basements* and to garages, plywood.

(3) Stairs and ramps, except those serving a single *dwelling unit*, *service rooms* or *service spaces*, shall have a colour contrast or a distinctive visual pattern to demarcate,
(a) the leading edge of the treads,
(b) the leading edge of the landing, and
(c) the beginning and end of a ramp.

(4) Except for stairs serving a single *dwelling unit*, *service rooms* or *service spaces*, a tactile attention indicator conforming to Article 3.8.3.18. shall be installed,
(a) at the top of the stairs starting one tread depth back from the edge of the top stair, and
(b) at the leading edge of landings where a doorway opens onto stairs.

(5) Treads and landings of interior and exterior stairs and ramps, other than those within *dwelling units*, shall have a slip-resistant finish or be provided with slip-resistant strips that extend not more than 1 mm above the surface.

9.8.10. Cantilevered Precast Concrete Steps

9.8.10.1. Design

(1) Exterior concrete steps and their anchorage system that are cantilevered from a *foundation* wall shall be designed and installed to support the loads to which they may be subjected.

9.8.10.2. Anchorage

(1) Cantilevered concrete steps referred to in Article 9.8.10.1. shall be anchored to concrete *foundation* walls at least 200 mm thick.

9.8.10.3. Prevention of Damage Due to Frost

(1) Suitable precautions shall be taken during backfilling and grading operations to ensure that subsequent freezing of the *soil* will not cause uplift forces on the underside of cantilevered concrete steps to the extent that the steps or the walls to which they are attached will be damaged.

Section 9.9. Means of Egress

9.9.1. General

9.9.1.1. Application

(1) Stairways, handrails and *guards* in a *means of egress* shall conform to the requirements in Section 9.8. as well as to the requirements in this Section.

9.9.1.2. Fire Protection

(1) In addition to the fire protection requirements provided in Subsection 9.9.4., *flame-spread ratings*, *fire-resistance ratings* and *fire-protection ratings* for *means of egress* shall conform to Section 9.10.

9.9.1.3. Occupant Load

(1) The *occupant load* of a *floor area* or part of a *floor area*, or of a *building* or part of a *building* not having a *floor area*, shall be based on,
(a) two persons per sleeping room or sleeping area in a *dwelling unit* or *suite*

9.9.2. Types and Purpose of Exits

9.9.2.1. Types of Exits

(1) Except as otherwise provided in this Section, an *exit* from any *floor area* shall be one of the following used singly or in combination:
(a) an exterior doorway,
(b) an exterior passageway,
(c) an exterior ramp, or
(d) an exterior stairway

(3) Fire escapes shall not be installed on any new *building*.

9.9.2.2. Purpose of Exits

(1) An *exit* shall be designed for no purpose other than for exiting, except that an *exit* may also serve as an access to a *floor area.*

9.9.2.3. Elevators, Slide Escapes and Windows as Means of Egress

(1) Elevators, slide escapes or windows shall not be considered as part of a required *means of egress.*

9.9.2.5. Front Edge of Stair Treads

(1) Except for curved stairs, the front edge of stair treads in *exits* and *access to exits* shall be at right angles to the direction of *exit* travel.

9.9.4. Fire Protection of Exits

9.9.4.6. Openings Near Exit Doors

(1) This Article applies to,
(a) *exit* doors serving other than single *dwelling units,* and
(b) *exit* doors serving single *dwelling units* where there is no second and separate *exit* from the *dwelling unit.*

(2) Where an exterior *exit* door described in Sentence (1) in one *fire compartment* is within 3 m horizontally of an *unprotected opening* in another *fire compartment* and the exterior walls of these *fire compartments* intersect at an exterior angle of less than 135°, the opening shall be protected with wired glass in fixed steel frames or glass block conforming to Articles 9.10.13.5. and 9.10.13.7. or with a rated *closure* conforming to Table 9.10.13.1. with respect to the rating of the *fire separation* between the two compartments.

9.9.6. Doors in a Means of Egress

9.9.6.4. Door Action

(1) Except as provided in Sentences (4) and (5), required *exit* doors and doors in required *means of egress,* except doors in *means of egress* within *dwelling units,* shall swing on the vertical axis.

(5) *Exit* doors need not conform to Sentence (1) or (2), where,
(a) the doors serve accessory *buildings* where life safety is not adversely affected, or
(b) the doors serve *storage garages* or other accessory *buildings* serving a single *dwelling unit.*

9.9.6.6. Proximity of Doors to Stairs

(1) Except as provided in Sentence (2), the distance between a stair riser and the leading edge of a door in its swing, except for doors serving a single *dwelling unit,* shall be not less than 300 mm.

(2) Where there is a danger of blockage from ice or snow, an *exit* door, including a door serving a single *dwelling unit,* may open onto not more than one step provided the riser of such step does not exceed 150 mm.

9.9.6.7. Door Latching, Locking and Opening Mechanisms

(1) Principal entrance doors, *exit* doors and doors to *suites*, including exterior doors to *dwelling units*, and other doors in an *access to exit* shall,
(a) be openable from the inside or in travelling to an *exit* without requiring keys, special devices or specialized knowledge of the door opening mechanism

(3) Door release hardware on doors in a *means of egress* shall be installed not more than 1 200 mm above the finished floor.

9.9.9. Egress from Dwelling Units

9.9.9.1. Travel Limit to Exits or Egress Doors

(1) Except as provided in Sentences (2) and (3), every *dwelling unit* containing more than 1 *storey* shall have *exits* or egress doors located so that it shall not be necessary to travel up or down more than 1 *storey* to reach a level served by,
(a) an egress door to a *public corridor*, enclosed *exit* stair or exterior passageway, or
(b) an *exit* doorway not more than 1 500 mm above adjacent ground level.

(2) Where a *dwelling unit* is not located above or below another *suite*, the travel limit from a floor level in the *dwelling unit* to an *exit* or egress door is permitted to exceed 1 *storey* where that floor level is served by an openable window or door,
(a) providing an unobstructed opening of not less than 1 000 mm in height and 550 mm in width, and
(b) located so that the sill is not more than,
  (i) 1 000 mm above the floor, and
  (ii) 7 m above adjacent ground level.

(3) The travel limit from a floor level in a *dwelling unit* to an *exit* or egress door is permitted to exceed 1 *storey* where that floor level has direct access to a balcony.

9.9.10. Egress from Bedrooms

9.9.10.1. Egress Windows or Doors for Bedrooms

(1) Except where a door on the same floor level as the bedroom provides direct access to the exterior, every floor level containing a bedroom in a *suite* shall be provided with at least one outside window that,
(a) is openable from the inside without the use of tools,
(b) provides an individual, unobstructed open portion having a minimum area of 0.35 m^2 with no dimension less than 380 mm, and
(c) maintains the required opening described in Clause (b) without the need for additional support.
(See Appendix A.)

(2) Except for *basement* areas, the window required in Sentence (1) shall have a maximum sill height of 1 000 mm above the floor. (See Appendix A.)

(3) When sliding windows are used, the minimum dimension described in Sentence (1) shall apply to the openable portion of the window.

(5) Where a window required in Sentence (1) opens into a window well, a clearance of not less than 550 mm shall be provided in front of the window. (See Appendix A.)

(6) Where the sash of a window referred to in Sentence (5) swings towards the window well, the operation of the sash shall not reduce the clearance in a manner that would restrict escape in an emergency.

(7) Where a protective enclosure is installed over the window well referred to in Sentence (5), such enclosure shall be openable from the inside without the use of keys, tools or special knowledge of the opening mechanism.

Section 9.10. Fire Protection

9.10.1. Definitions and Application

9.10.1.1. Support of Noncombustible Construction

(1) Where an assembly is required to be of *noncombustible construction* and to have a *fire-resistance rating*, it shall be supported by *noncombustible construction.*

9.10.1.2. Sloped Roofs

(1) For the purposes of this Section, roofs with slopes of 60° or more to the horizontal and that are adjacent to a room or space intended for occupancy shall be considered as a wall.

9.10.3. Ratings

9.10.3.1. Fire-Resistance and Fire-Protection Ratings

(1) Where a *fire-resistance rating* or a *fire-protection rating* is required in this Section for an element of a *building*, such rating shall be determined in conformance with the test methods described in Part 3, or in accordance with MMAH Supplementary Standard SB-2, "Fire Performance Ratings", or MMAH Supplementary Standard SB-3, "Fire and Sound Resistance of Building Assemblies". (See Appendix A.)

9.10.3.2. Flame-Spread Rating

(1) Where a *flame-spread rating* is required in this Section for an element of a *building*, such rating shall be determined in accordance with the test methods described in Part 3, or in accordance with MMAH Supplementary Standard SB-2, "Fire Performance Ratings".

(2) Unless the *flame-spread rating* is referred to in this Part as a "surface *flame-spread rating*", it shall apply to any surface of the element being considered that would be exposed by cutting through it as well as to the exposed surface of the element.

9.10.3.3. Fire Exposure

(2) Exterior walls shall be rated for exposure to fire from inside the *building*, except that such walls need not comply with the temperature rise limitations required by the standard tests referred to in Article 9.10.3.1. if such walls have a *limiting distance* of not less than 1.2 m, and due allowance is made for the effects of heat radiation in accordance with the requirements in Part 3.

(3) *Firewalls* and interior vertical *fire separations* required to have *fire-resistance ratings* shall be rated for exposure to fire on each side.

9.10.4. Building Size Determination

9.10.4.1. Mezzanines Not Considered as Storeys

(1) *Mezzanines* shall not be considered as *storeys* for the purpose of determining *building height* where the aggregate area of *mezzanine* floors does not exceed 10% of,
(a) the *suite* in which it is located, where there is more than one *suite* in the *storey*, or
(b) the *storey* in which it is located, in all other cases.

(2) *Mezzanines* shall not be considered as *storeys* for the purpose of determining *building height* where they occupy an aggregate area not exceeding 40% of the area of the room or the *storey* in which they are located provided the space above the *mezzanine* floor has no visual obstructions more than 1 070 mm above such floors.

9.10.4.2. More Than One Level of Mezzanine

(1) Where more than 1 level of *mezzanine* is provided in a *storey*, each level additional to the first shall be considered as a *storey*.

9.10.5. Permitted Openings in Wall and Ceiling Assemblies

9.10.5.1. Permitted Openings in Wall and Ceiling Membranes

(1) Except as permitted in Sentences (2) and (4), a membrane forming part of an assembly required to have a *fire-resistance rating* shall not be pierced by openings into the assembly unless the assembly has been tested and rated for such openings.

(2) A wall or ceiling membrane forming part of an assembly required to have a *fire-resistance rating* is permitted to be pierced by openings for electrical and similar service outlet boxes provided such outlet boxes are tightly fitted.

(3) Where boxes referred to in Sentence (2) are located on both sides of walls required to provide a *fire-resistance rating*, they shall be offset where necessary to maintain the integrity of the *fire separation*.

9.10.7. Steel Members

9.10.7.1. Protection of Structural Steel Members

(1) Except as provided in Article 3.2.2.3., structural steel members used in construction required to have a *fire-resistance rating* shall be protected to provide the required *fire-resistance rating*.

9.10.9. Fire Separations Between Rooms and Spaces Within Buildings

9.10.9.1. Application

(1) This Subsection applies to *fire separations* required between rooms and spaces in *buildings* except between rooms and spaces within a *dwelling unit*.

9.10.9.2. Continuous Barrier

(1) Except as permitted in Article 9.10.9.3., a wall or floor assembly required to be a *fire separation* shall be constructed as a continuous barrier against the spread of fire.

(2) The continuity of a *fire separation* shall be maintained where it abuts another *fire separation*, a floor, a ceiling, a roof or an exterior wall assembly.

9.10.9.3. Openings to be Protected With Closures

(1) Except as permitted in Articles 9.10.9.5. to 9.10.9.7., openings in required *fire separations* shall be protected with *closures* conforming to Subsection 9.10.13.

9.10.9.6. Penetration of Fire Separations

(1) Piping, tubing, ducts, *chimneys*, wiring, conduit, electrical outlet boxes and other similar service equipment that penetrate a required *fire separation* shall be tightly fitted or fire stopped to maintain the integrity of the separation. (See Appendix A.)

(2) Penetrations of a *firewall* shall be sealed at the penetration by a *fire stop* that, when subjected to the fire test method in CAN/ULC-S115, "Fire Tests of Firestop Systems", has an FT rating not less than the *fire-resistance rating* for the *fire separation*.

(3) Except as provided in Sentences (4) to (12) and Article 9.10.9.7., pipes, ducts, electrical outlet boxes, totally enclosed raceways or other similar service equipment that partly or wholly penetrate an assembly required to have a *fire-resistance rating* shall be *noncombustible* unless the assembly has been tested incorporating such equipment.

(4) Electrical wires or other similar wiring enclosed in *noncombustible* totally enclosed raceways are permitted to partly or wholly penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (3).

(5) Single conductor metal-sheathed cables with *combustible* jacketing that are more than 25 mm in overall diameter are permitted to penetrate a *fire separation* required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (3), provided the cables are not grouped and are spaced a minimum of 300 mm apart.

(6) Electrical wires or cables, single or grouped, with *combustible* insulation or jacketing that is not totally enclosed in raceways of *noncombustible* material, are permitted to partly or wholly penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (3), provided the overall diameter of the wiring is not more than 25 mm.

(7) *Combustible* totally enclosed raceways that are embedded in a concrete floor slab are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (3), where the concrete provides at least 50 mm of cover between the raceway and the bottom of the slab.

(8) *Combustible* outlet boxes are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (3), provided the opening through the membrane into the box does not exceed 160 cm^2.

(9) *Combustible* water distribution piping is permitted to partly or wholly penetrate a *fire separation* that is required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (3), provided the piping is protected with a *fire stop* in conformance with Sentence 3.1.9.4.(4).

3.1.9. Penetrations in Fire Separations and Fire-Rated Assemblies (See Appendix A.)

3.1.9.1. Fire Stops

(1) Except as required by Sentences (2) and (3) and permitted by Sentences (4) and (5), penetrations of a *fire separation* or a membrane forming part of an assembly required to have a *fire-resistance rating* shall be,
(a) sealed by a *fire stop* that, when subjected to the fire test method in CAN/ULC-S115, "Fire Tests of Firestop Systems", has an F rating not less than the *fire-protection rating* required for *closures* in the *fire separation* in conformance with Table 3.1.8.4., or
(b) tightly fitted. (See Appendix A.)

9.10.9.7. Combustible Piping

(1) Except as permitted in Sentences (2) to (6), *combustible* piping shall not be used where any part of a piping system partly or wholly penetrates a *fire separation* required to have a *fire-resistance rating* or penetrates a membrane that contributes to the required *fire-resistance rating* of an assembly.

(2) *Combustible* piping not located in a vertical shaft is permitted to penetrate a *fire separation* required to have a *fire-resistance rating* or a membrane that forms part of an assembly required to have a *fire-resistance rating*, provided the piping is sealed at the penetration by a *fire stop* system that has an F rating not less than the *fire-resistance rating* required for the *fire separation.*

(3) The rating referred to in Sentence (2) shall be based on CAN/ULC-S115, "Fire Tests of Firestop Systems", with a pressure differential of 50 Pa between the exposed and unexposed sides, with the higher pressure on the exposed side.

(5) *Combustible* piping is permitted,
(a) on one side of a vertical *fire separation* provided it is not located in a vertical shaft, and
(b) to penetrate a vertical or horizontal *fire separation* when the *fire compartment* on each side of the *fire separation* is *sprinklered.*

9.10.9.8. Collapse of Combustible Construction

(1) *Combustible construction* that abuts on or is supported by a *noncombustible fire separation* shall be constructed so that its collapse under fire conditions will not cause collapse of the *fire separation.*

9.10.9.9. Reduction in Thickness of Fire Separation by Beams and Joists

(1) Where pockets for the support of beams or joists are formed in a masonry or concrete *fire separation*, the remaining total thickness of solid masonry and/or grout and/or concrete shall be not less than the required equivalent thickness shown for Type S monolithic concrete in Table 2.1.1. of MMAH Supplementary Standard SB-2, "Fire Performance Ratings", for the required *fire-resistance rating.*

9.10.9.16. Separation of Storage Garages

(2) Except as permitted in Sentence (3), *storage garages* containing 5 motor vehicles or fewer shall be separated from other *occupancies* by a *fire separation* of not less than 1 h.

(3) Where a *storage garage* serves only the *dwelling unit* it is attached to or built into, it shall be considered as part of that *dwelling unit* and the *fire separation* required in Sentence (2) need not be provided between the garage and the *dwelling unit.*

(4) Where a *storage garage* is attached to or built into a *building* of *residential occupancy*,
(a) an *air barrier system* conforming to Subsection 9.25.3. shall be installed between the garage and the remainder of the *building* to provide an effective barrier to gas and exhaust fumes, and
(b) every door between the garage and the remainder of the *building* shall conform to Article 9.10.13.15.
(See Appendix A.)

(5) Where membrane materials are used to provide the required airtightness in the *air barrier system*, all joints shall be sealed and structurally supported.

9.10.11. Firewalls

9.10.11.1. Required Firewalls

(1) Except as provided in Articles 9.10.11.2. and 9.10.11.4., a *party wall* on a property line shall be constructed as a *firewall.*

9.10.11.2. Firewalls Not Required

(1) In a *building* of *residential occupancy* in which there is no *dwelling unit* above another *dwelling unit*, a *party wall* on a property line between *dwelling units* need not be constructed as a *firewall* provided it is constructed as a *fire separation* having not less than a 1 h *fire-resistance rating.*

(2) The wall described in Sentence (1) shall provide continuous protection from the top of the footings to the underside of the roof deck.

(3) Any space between the top of the wall described in Sentence (1) and the roof deck shall be tightly filled with mineral wool or *noncombustible* material.

9.10.11.3. Construction of Firewalls

(1) Where *firewalls* are used, the requirements in Part 3 shall apply.

9.10.11.4. Firewalls in Detached Garages

(1) Where a garage is detached from the *dwelling unit* but attached to another garage on the adjacent property, the *party wall* so formed shall be constructed as a *fire separation* having a *fire-resistance rating* of not less than 45 min.

9.10.12. Prevention of Fire Spread at Exterior Walls and Between Storeys

9.10.12.2. Location of Skylights

(1) Where a wall in a *building* is exposed to a fire hazard from an adjoining roof of a separate unsprinklered *fire compartment* in the same *building,* the roof shall contain no skylights within a horizontal distance of 5 m of the windows in the exposed wall.

9.10.12.3. Exterior Walls Meeting at an Angle

(1) Except as provided in Article 9.9.4.5., where exterior walls of a *building* meet at an external angle of less than 135°, the horizontal distance from an opening in one wall to an opening in the other wall shall be not less than 1.2 m where the openings are in different *fire compartments.*

(2) The exterior wall of each *fire compartment* referred to in Sentence (1) within the 1.2 m distance, shall have a *fire-resistance rating* not less than that required for the interior vertical *fire separation* between the compartment and the remainder of the *building.*

9.10.12.4. Protection of Soffits

(1) This Article applies to the portion of any soffit enclosing a projection that is,
(a) less than 2.5 m vertically above a window or door, and
(b) less than 1.2 m from either side of the window or door.
(See Appendix A.)

(2) Except as provided in Sentences (4) and (5), the soffit described in Sentence (1) shall be protected in accordance with Sentence (3) where the soffit encloses,
(a) a common *attic or roof space* that spans more than 2 *suites* of *residential occupancy* and projects beyond the exterior wall of the *building,*
(b) a floor space where an upper *storey* projects beyond the exterior wall of a lower *storey* and a *fire separation* is required at the floor between the two *storeys,* or

(c) a floor space where an upper *storey* projects beyond the exterior wall of a lower *storey*, and the projection is continuous across a vertical *fire separation* separating two *suites*.

(3) Protection required by Sentence (2) shall be provided by,
(a) *noncombustible* material having a minimum thickness of 0.38 mm and a melting point not below 650°C,
(b) not less than 12.7 mm thick gypsum soffit board or gypsum wallboard installed according to CSA A82.31-M, "Gypsum Board Application,"
(c) not less than 11 mm thick plywood,
(d) not less than 12.5 mm thick OSB or waferboard, or
(e) not less than 11 mm thick lumber.
(See Appendix A.)

(4) In the case of a soffit described in Sentence (1) that is at the edge of an *attic or roof space*, and completely separated from the remainder of the *attic or roof space* by *fire blocks*, the requirements in Sentence (2) do not apply.

(5) Where all *suites* spanned by a common *attic or roof space* or situated above or below the projecting floor are *sprinklered*, the requirements in Sentence (2) do not apply provided that all rooms, including closets and bathrooms, having openings in the wall beneath the soffit are *sprinklered*, notwithstanding any exceptions in the sprinkler standards referenced in Article 3.2.5.13.

9.10.13. Doors, Dampers and Other Closures in Fire Separations

9.10.13.1. Closures

(1) Except as provided in Article 9.10.13.2., openings in required *fire separations* shall be protected with a *closure* conforming to Table 9.10.13.1. and shall be installed in conformance with NFPA 80, "Fire Doors and Other Opening Protectives", unless otherwise specified in this Part.

Table 9.10.13.1.
Fire-Protection Ratings for Closures
Forming Part of Sentence 9.10.13.1.(1)

Required Fire-Resistance Rating of Fire Separation	Required Fire-Protection Rating of Closure
30 or 45 min	20 min(1)
1 h	45 min(1)
1.5 h	1 h
2 h	1.5 h
3 h	2 h
4 h	3 h
Column 1	2

Notes to Table 9.10.13.1.:
(1) See Article 9.10.13.2.

9.10.13.5. Wired Glass as a Closure

(1) Wired glass conforming to Article 9.6.1.2. that has not been tested in accordance with Article 9.10.3.1. is permitted as a *closure* in a vertical *fire separation* required to have a *fire-resistance rating* of not more than 1 h provided such glass is not less than 6 mm thick and is mounted in conformance with Sentence (2).

(2) Wired glass described in Sentence (1) shall be mounted in fixed steel frames having a minimum metal thickness of not less than 1.35 mm and a glazing stop of not less than 20 mm on each side of the glass.

(3) Individual panes of glass described in Sentence (1) shall not exceed 0.8 m^2 in area or 1.4 m in height or width, and the area of glass not structurally supported by mullions shall not exceed 7.5 m^2.

9.10.13.7. Glass Block as a Closure

(1) Glass block that has not been tested in accordance with Article 9.10.3.1. is permitted as a *closure* in a *fire separation* required to have a *fire-resistance rating* of not more than 1 h.

9.10.13.15. Doors Between Garages and Dwelling Units

(1) A door between an attached or built-in garage and a *dwelling unit* shall be tight-fitting and weatherstripped to provide an effective barrier against the passage of gases and exhaust fumes and shall be fitted with a self-closing device.

(2) A doorway between an attached or built-in garage and a *dwelling unit* shall not be located in a room intended for sleeping.

9.10.13.16. Door Stops

(1) Where a door is installed so that it may damage the integrity of a *fire separation* if its swing is unrestricted, door stops shall be installed to prevent such damage.

9.10.14. Spatial Separation Between Buildings

9.10.14.1. Application

(1) Except as permitted in Subsection 9.10.15., this Subsection applies to all *buildings*.

9.10.14.2. Area and Location of Exposing Building Face

(1) The area of an *exposing building face* shall be,
(a) taken as the exterior wall area facing in one direction on any side of a *building*, and
(b) calculated as,
  (i) the total area measured from the finished ground level to the uppermost ceiling, or
  (ii) the area for each *fire compartment*, where a *building* is divided into *fire compartments* by *fire separations* with *fire-resistance ratings* not less than 45 min.

(2) For the purpose of using Table 9.10.14.4. to determine the maximum aggregate area of *unprotected openings* permitted in an irregularly-shaped or skewed exterior wall, the location of the *exposing building face* shall be taken as a vertical plane located so that there are no *unprotected openings* between the vertical plane and the line to which *limiting distance* is measured.

(3) For the purpose of using Table 9.10.14.5. to determine the required type of construction, cladding and *fire-resistance rating* for an irregularly-shaped or skewed exterior wall,
(a) the *exposing building face* is permitted to be divided into any number of portions and the *fire-resistance rating*, type of cladding and percentage of *unprotected openings* limitations is permitted to be determined individually for each portion based on the *limiting distance* for each portion so divided,
(b) the *exposing building face* shall be taken as the projection of the exterior wall onto a vertical plane located so that no portion of the exterior wall of the *building* is between the vertical plane and the line to which the *limiting distance* is established in Clause (a), and
(c) for the purpose of determining the actual area of *unprotected openings* permitted in an exterior wall, the *unprotected openings* shall be projected onto the vertical plane established in Clause (b).

(4) The required *limiting distance* for an *exposing building face* is permitted to be measured to a point beyond the property line that is not the centre line of a *street*, lane or public thoroughfare if,
(a) the owners of the properties on which the *limiting distance* is measured and the *municipality* enter into an agreement in which such owners agree that,
  (i) each owner covenants that, for the benefit of land owned by the other covenantors, the owner will not *construct* a *building* on his or her property unless the *limiting distance* for *exposing building faces* in respect of the proposed *construction* is measured in accordance with the agreement,

(ii) the covenants contained in the agreement are intended to run with the lands, and the agreement shall be binding on the parties and their respective heirs, executors, administrators, successors and assigns,
(iii) the agreement shall not be amended or deleted from title without the consent of the *municipality*, and
(iv) they will comply with such other conditions as the *municipality* considers necessary, including indemnification of the *municipality* by the other parties, and
(b) the agreement referred to in Clause (a) is registered against the title of the properties to which it applies.

(5) Where an agreement referred to in Sentence (4) is registered against the title of a property, the *limiting distance* for *exposing building faces* in respect of the *construction* of any *buildings* on the property shall be measured to the point referred to in the agreement.

9.10.14.3. Inadequate Firefighting Facilities

(1) Where there is no fire department or where a fire department is not organized, trained and equipped to meet the needs of the community, the required *limiting distance* determined from Sentences 9.10.14.4.(2), (5) and (6) and Sentence 9.10.14.5.(6), shall be doubled for a *building* that is not *sprinklered*.

9.10.14.4. Openings in Exposing Building Face

(1) Except as provided in Sentences (3) to (7) and Sentence 9.10.14.6.(1), the maximum aggregate area of *unprotected openings* in an *exposing building face* shall,
(a) conform to Table 9.10.14.4.,
(b) conform to Subsection 3.2.3., or
(c) where the limiting distance is not less than 1.2 m, be equal to or less than,
(i) the *limiting distance* squared, for *residential occupancies*, *business and personal services occupancies* and *low hazard industrial occupancies*, and
(ii) half the *limiting distance* squared, for *mercantile occupancies* and *medium hazard industrial occupancies*.

(2) Except as provided in Sentence 9.10.14.6.(1), openings in a wall having a *limiting distance* of less than 1.2 m shall be protected by *closures*, of other than wired glass or glass block, whose *fire protection rating* is in conformance with the *fire-resistance rating* required for the wall.

(3) The maximum aggregate area of *unprotected openings* shall be not more than twice the area determined according to Sentence (1) where the *unprotected openings* are glazed with,
(a) wired glass in steel frames as described in Article 9.10.13.5., or
(b) glass blocks, as described in Article 9.10.13.7.

(4) Where the *building* is *sprinklered*, the maximum aggregate area of *unprotected openings* shall be not more than twice the area determined according to Sentence (1) provided all rooms, including closets and bathrooms, that are adjacent to the *exposing building face* and that have *unprotected openings* are *sprinklered*, notwithstanding any exemptions in the sprinkler standards referenced in Article 3.2.5.13.

(5) The maximum aggregate area of *unprotected openings* in an *exposing building face* of a *storage garage* need not comply with Sentence (1) where,
(a) all *storeys* are constructed as *open-air storeys*, and
(b) the *storage garage* has a *limiting distance* of not less than 3 m.

(6) The maximum aggregate area of *unprotected openings* in an *exposing building face* of a *storey* that faces a *street* and is the same level as the *street* need not comply with Sentence (1) where the *limiting distance* is not less than 9 m.

(7) The limits on the area of *unprotected openings* need not apply to the *exposing building face* of a detached garage or accessory *building* facing a *dwelling unit*, where,
(a) the detached garage or accessory *building* serves a single *dwelling unit*,
(b) the detached garage or accessory *building* is located on the same property as that *dwelling unit*, and
(c) the *dwelling unit* served by the detached garage or accessory *building* is the only *major occupancy* on the property.

Table 9.10.14.4.
Maximum Aggregate Area of Unprotected Openings in Exterior Walls
Forming Part of Sentence 9.10.14.4.(1)

Occupancy Classification of Building	Maximum Total Area of Exposing Building Face, m²	Maximum Aggregate Area of Unprotected Openings, % of Exposing Building Face Area													
		Limiting Distance, m													
		Less than 1.2	1.2	1.5	2	2.5	3	4	6	8	10	12	16	20	25
Residential, business and personal services, and low-hazard industrial	10	0	8	12	21	33	55	96	100	—	—	—	—	—	—
	15	0	8	10	17	25	37	67	100	—	—	—	—	—	—
	20	0	8	10	15	21	30	53	100	—	—	—	—	—	—
	25	0	8	9	13	19	26	45	100	—	—	—	—	—	—
	30	0	7	9	12	17	23	39	88	100	—	—	—	—	—
	40	0	7	8	11	15	20	32	69	100	—	—	—	—	—
	50	0	7	8	10	14	18	28	57	100	—	—	—	—	—
	100	0	7	8	9	11	13	18	34	56	84	100	—	—	—
	Over 100	0	7	7	8	9	10	12	19	28	40	55	92	100	—
Mercantile and medium-hazard industrial	10	0	4	6	10	17	25	48	100	—	—	—	—	—	—
	15	0	4	5	8	13	18	34	82	100	—	—	—	—	—
	20	0	4	5	7	11	15	27	63	100	—	—	—	—	—
	25	0	4	5	7	9	13	22	51	94	100	—	—	—	—
	30	0	4	4	6	9	12	20	44	80	100	—	—	—	—
	40	0	4	4	6	8	10	16	34	61	97	100	—	—	—
	50	0	4	4	5	7	9	14	29	50	79	100	—	—	—
	100	0	4	4	4	5	6	9	17	28	42	60	100	—	—
	Over 100	0	4	4	4	4	5	6	10	14	20	27	46	70	100
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

9.10.14.5. Construction of Exposing Building Face and Walls Above Exposing Building Face

(1) Except as provided in Sentences (2) to (7), each *exposing building face* and any exterior wall located above an *exposing building face* that encloses an *attic or roof space* shall be constructed in conformance with Table 9.10.14.5. and Subsection 9.10.8.

Table 9.10.14.5.
Minimum Construction Requirements for Exposing Building Faces
Forming Part of Sentences 9.10.14.5.(1) to (3)

Occupancy Classification of Building	Maximum Area of Unprotected Openings Permitted, % of Exposing Building Face Area	Minimum Required Fire-Resistance Rating	Type of Construction Required	Type of Cladding Required
Residential, business and personal services, and low-hazard industrial	0 - 10	1 h	Noncombustible	Noncombustible
	>10 but ≤25	1 h	Combustible or noncombustible	Noncombustible
	>25 but <100	45 min	Combustible or noncombustible	Combustible or noncombustible
Mercantile and medium-hazard industrial	0 - 10	2 h	Noncombustible	Noncombustible
	>10 but ≤25	2 h	Combustible or noncombustible	Noncombustible
	>25 but <100	1 h	Combustible or noncombustible	Combustible or noncombustible
Column 1	2	3	4	5

(2) Cladding on *exposing building faces* and exterior walls located above *exposing building faces* need not conform to the type of cladding required by Table 9.10.14.5. where,
(a) the *exposing building face* is constructed with no *unprotected openings*,
(b) the *limiting distance* is not less than 0.6 m, and
(c) the cladding,
  (i) conforms to Subsection 9.27.12.,
  (ii) is installed without furring members over not less than 12.7 mm thick gypsum sheathing or over masonry,
  (iii) has a *flame-spread rating* not more than 25 when tested in accordance with Sentence 3.1.12.1.(2), and
  (iv) is not more than 2 mm in thickness exclusive of fasteners, joints and local reinforcements.

(3) Except as provided in Sentence (4), where a garage or accessory *building* serves a single *dwelling unit* and is detached from any *building*, the *exposing building face*,
(a) need not conform to the minimum required *fire-resistance rating* in Table 9.10.14.5., where the *limiting distance* is 0.6 m or more,
(b) shall have a *fire-resistance rating* of not less than 45 min where the *limiting distance* is less than 0.6 m, and
(c) need not conform to the type of cladding required in Table 9.10.14.5. regardless of the *limiting distance.*

(4) The requirements for *fire-resistance rating*, type of construction and type of cladding need not apply to the *exposing building faces* of a *dwelling unit* and a detached garage or accessory *building* that face each other, where,
(a) the detached garage or accessory *building* serves a single *dwelling unit*,
(b) the detached garage or accessory *building* is located on the same property as that *dwelling unit*, and
(c) the *dwelling unit* served by the detached garage or accessory *building* is the only *major occupancy* on the property.

(5) Except for *buildings* containing 1 or 2 *dwelling units* only, *combustible* projections on the exterior of a wall that are more than 1 000 mm above ground level, such as balconies, platforms, *canopies*, eave projections and stairs, and that could expose an adjacent *building* to fire spread, shall not be permitted within,
(a) 1.2 m of a property line or the centre line of a *public way*, or
(b) 2.4 m of a *combustible* projection on another *building* on the same property.

(6) Heavy timber and steel columns need not conform to the requirements of Sentence (1) provided the *limiting distance* is not less than 3 m.

(7) Non-*loadbearing* wall components need not have a minimum *fire-resistance rating* where,
(a) the *building* is 1 *storey* in *building height*,
(b) the *building* is of *noncombustible construction*,
(c) the *building* is classified as *low hazard industrial occupancy* and is used only for low *fire load occupancies* such as power generating plants or plants for the manufacture or storage of *noncombustible* materials, and
(d) the *exposing building face* has a *limiting distance* of 3 m or more.

9.10.14.6. Minor Openings in Exposing Building Face

(1) An opening in an *exposing building face* not more than 130 cm^2 shall not be considered an *unprotected opening*.

9.10.15. Spatial Separation Between Houses

9.10.15.1. Application

(1) This Subsection applies to *buildings* that,
(a) contain only *dwelling units* and have no *dwelling unit* above another *dwelling unit*, and
(b) are not designed in accordance with Subsection 9.10.14.
(See Appendix A.)

9.10.15.2. Area and Location of Exposing Building Face

(1) The area of an *exposing building face* shall be,
(a) taken as the exterior wall area facing in one direction on any side of a *building*, and
(b) calculated as,
 (i) the total area measured from the finished ground level to the uppermost ceiling,
 (ii) the area for each *fire compartment* where a *building* is divided into *fire compartments* by *fire separations* with *fire-resistance ratings* not less than 45 min, or
 (iii) where Table 9.10.15.4. is used to determine maximum area of glazed openings, the area of any number of individual vertical portions of the wall measured from the finished ground level to the uppermost ceiling.

(2) For the purpose of using Table 9.10.15.4. to determine the maximum permitted area of glazed openings in an irregularly-shaped or skewed exterior wall, the location of the *exposing building face* shall be taken as a vertical plane located so that there are no glazed openings between the vertical plane and the line to which the *limiting distance* is measured.

(3) In determining the required cladding-sheathing assembly and *fire-resistance rating* for an irregularly-shaped or skewed exterior wall, the location of the *exposing building face* shall be taken as a vertical plane located so that no portion of the actual *exposing building face* is between the vertical plane and the line to which the *limiting distance* is measured.

(4) The required *limiting distance* for an *exposing building face* is permitted to be measured to a point beyond the property line that is not the centre line of a *street*, lane or public thoroughfare if,
(a) the owners of the properties on which the *limiting distance* is measured and the *municipality* enter into an agreement in which such owners agree that,
 (i) each owner covenants that, for the benefit of land owned by the other covenantors, the owner will not *construct* a *building* on his or her property unless the *limiting distance* for *exposing building faces* in respect of the proposed *construction* is measured in accordance with the agreement,
 (ii) the covenants contained in the agreement are intended to run with the lands, and the agreement shall be binding on the parties and their respective heirs, executors, administrators, successors and assigns,
 (iii) the agreement shall not be amended or deleted from title without the consent of the *municipality*, and
 (iv) they will comply with such other conditions as the *municipality* considers necessary, including indemnification of the *municipality* by the other parties, and
(b) the agreement referred to in Clause (a) is registered against the title of the properties to which it applies.

(5) Where an agreement referred to in Sentence (4) is registered against the title of a property, the *limiting distance* for *exposing building faces* in respect of the *construction* of any *buildings* on the property shall be measured to the point referred to in the agreement.

9.10.15.3. Inadequate Firefighting Facilities

(1) Where there is no fire department or where a fire department is not organized, trained and equipped to meet the needs of the community, the required *limiting distance* determined from Sentences 9.10.15.4.(2) and (5) and Sentence 9.10.15.5.(6), shall be doubled for a *building* that is not *sprinklered.*

9.10.15.4. Glazed Openings in Exposing Building Face

(1) Except as provided in Sentences (3) to (5), the maximum area of glazed openings in an *exposing building face* shall,
(a) conform to Table 9.10.15.4.,
(b) conform to Subsection 3.2.3. as if the glazed openings were *unprotected openings*, or
(c) where the *limiting distance* is not less than 1.2 m, be equal to or less than the *limiting distance* squared.

Table 9.10.15.4.
Maximum Area of Glazed Openings in Exterior Walls of Houses
Forming Part of Sentences 9.10.15.4.(1) and (2)

Maximum Total Area of Exposing Building Face, m^2	Maximum Aggregate Area of Glazed Openings, % of Exposing Building Face Area													
	Limiting Distance, m													
	Less than 1.2	1.2	1.5	2	2.5	3	4	6	8	10	12	16	20	25
10	0	8	12	21	33	55	96	100	—	—	—	—	—	—
15	0	8	10	17	25	37	67	100	—	—	—	—	—	—
20	0	8	10	15	21	30	53	100	—	—	—	—	—	—
25	0	8	9	13	19	26	45	100	—	—	—	—	—	—
30	0	7	9	12	17	23	39	88	100	—	—	—	—	—
40	0	7	8	11	15	20	32	69	100	—	—	—	—	—
50	0	7	8	10	14	18	28	57	100	—	—	—	—	—
100	0	7	8	9	11	13	18	34	56	84	100	—	—	—
Over 100	0	7	7	8	9	10	12	19	28	40	55	92	100	—
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

(2) Where the limits on the area of glazed openings are determined for individual portions of the exterior wall, as described in Subclause 9.10.15.2.(1)(b)(iii), the maximum aggregate area of glazed openings for any portion shall not exceed the values in the row of Table 9.10.15.4. for the total area of the entire *exposing building face* based on the *limiting distance* of the individual portion. (See Appendix A.)

(3) The limits on the area of glazed openings shall not apply to the *exposing building face* of a *dwelling unit* facing a detached garage or accessory *building*, where,
(a) the detached garage or accessory *building* serves only one *dwelling unit*,
(b) the detached garage or accessory *building* is located on the same property as that *dwelling unit*, and
(c) the *dwelling unit* served by the detached garage or accessory *building* is the only *major occupancy* on the property.

(4) Except as provided in Sentence (5), openings in a wall having a *limiting distance* of less than 1.2 m shall be protected by *closures*, of other than wired glass or glass block, whose *fire-protection rating* is in conformance with the *fire-resistance rating* required for the wall.

(5) An opening in an *exposing building face* not more than 130 cm^2 shall not be considered an *unprotected opening.*

9.10.15.5. Construction of Exposing Building Face of Houses

(1) Except as provided in Sentences (2) to (4) and (6), each *exposing building face* and any exterior wall located above an *exposing building face* that encloses an *attic or roof space* shall be constructed in conformance with Subsection 9.10.8.,
(a) for the *exposing building face* as a whole, or
(b) for any number of separate portions of the *exposing building face*.

(2) Sentence (1) does not apply where,
(a) the *limiting distance* is not less than 1.2 m,
(b) the *limiting distance* is less than 1.2 m but not less than 0.6 m, provided that the *exposing building face* has a *fire-resistance rating* of not less than 45 min, or
(c) the *limiting distance* is less than 0.6 m, provided that the *exposing building face* has a *fire-resistance rating* of not less than 45 min and is clad with *noncombustible* material.

(3) Where the *limiting distance* is less than 0.6 m, cladding on the *exposing building face* and on exterior walls located above the *exposing building face* that enclose an *attic or roof spaces* need not be *noncombustible*, provided the cladding,
(a) conforms to Subsection 9.27.12.,
(b) is installed without furring members over not less than 12.7 mm thick gypsum sheathing or over masonry,
(c) has a *flame-spread rating* not more than 25 when tested in accordance with Sentence 3.1.12.1.(2), and
(d) is not more than 2 mm in thickness exclusive of fasteners, joints and local reinforcements.

(4) The requirements for *fire-resistance rating*, type of construction and type of cladding need not apply to the *exposing building faces* of a *dwelling unit* and a detached garage or accessory *building* that face each other, where,
(a) the detached garage or accessory *building* serves a single *dwelling unit*,
(b) the detached garage or accessory *building* is located on the same property as that *dwelling unit*, and
(c) the *dwelling unit* served by the detached garage or accessory *building* is the only *major occupancy* on the property.

(5) Except for *buildings* containing 1 or 2 *dwelling units* only, *combustible* projections on the exterior of a wall that are more than 1 000 mm above ground level, such as balconies, platforms, *canopies*, eave projections and stairs, and that could expose an adjacent *building* to fire spread, shall not be permitted within,
(a) 1.2 m of a property line or the centre line of a *public way*, or
(b) 2.4 m of a *combustible* projection on another *building* on the same property.

(6) Heavy timber and steel columns need not conform to the requirements of Sentence (1) provided the *limiting distance* is not less than 3 m.

9.10.16. Fire Blocks

9.10.16.1. Required Fire Blocks in Concealed Spaces

(1) Concealed spaces in interior walls, ceilings, floors and crawl spaces shall be separated by *fire blocks* from concealed spaces in exterior walls and *attic or roof spaces*.

(2) *Fire blocks* shall be provided at all interconnections between concealed vertical and horizontal spaces in interior coved ceilings, drop ceilings and soffits where the exposed construction materials within the concealed spaces have a surface *flame-spread rating* greater than 25.

(3) *Fire blocks* shall be provided at the top and bottom of each run of stairs where they pass through a floor containing concealed space in which the exposed construction materials within the space have a surface *flame-spread rating* greater than 25.

(4) In unsprinklered *buildings* of *combustible construction*, every concealed space created by a ceiling, roof space or unoccupied attic space shall be separated by *fire blocks* into compartments of not more than 300 m^2 in area where such space contains exposed construction materials having a surface *flame-spread rating* greater than 25.

(5) No dimension of the concealed space described in Sentence (4) shall exceed 20 m.

(6) Concealed spaces in mansard or gambrel style roofs, exterior cornices, balconies and canopies of *combustible construction* in which the exposed construction materials within the space have a surface *flame-spread rating* exceeding 25 shall have vertical *fire blocks* at intervals of not more than 20 m and at points where such concealed spaces extend across the ends of required vertical *fire separations*.

9.10.16.2. Required Fire Blocks in Wall Assemblies

(1) Except as permitted in Sentence (2), *fire blocks* shall be provided to block off concealed spaces within wall assemblies, including spaces created by furring,
(a) at each floor level,
(b) at each ceiling level where the ceiling contributes to part of the required *fire-resistance rating*, and
(c) at other locations within the wall, so that the distance between *fire blocks* does not exceed 20 m horizontally and 3 m vertically.

(2) *Fire blocks* required in Sentence (1) need not be provided, if,
(a) the insulated wall assembly contains not more than one concealed air space and the horizontal thickness of that air space is not more than 25 mm,
(b) the exposed construction materials within the space are *noncombustible*, or
(c) the exposed construction materials within the space, including insulation, but not including wiring, piping or similar services, have a *flame-spread rating* of not more than 25.

9.10.16.3. Fire Block Materials

(1) Except as permitted in Sentences (2) and (3), *fire blocks* shall be constructed of materials that will remain in place and prevent the passage of flames for not less than 15 min when subjected to the standard fire exposure in CAN/ULC-S101, "Fire Endurance Tests of Building Construction and Materials".

(2) *Fire blocks* are deemed to comply with Sentence (1), if they are constructed of not less than,
(a) 0.38 mm sheet steel,
(b) 12.7 mm gypsum wallboard,
(c) 12.5 mm plywood, OSB or waferboard, with joints having continuous supports,
(d) 2 layers of 19 mm lumber with joints staggered, or
(e) 38 mm lumber.

(3) In a *building* permitted to be of *combustible construction*, semi-rigid fibre insulation board produced from glass, rock or slag, is permitted to be used to block the vertical space in a double-frame wall assembly formed at the intersection of the floor assembly and the walls, provided the width of the vertical space is not more than 25 mm and the insulation board,
(a) has a density not less than 45 kg/m^3,
(b) is securely fastened to one set of studs,
(c) extends from below the bottom of the top plates in the lower *storey* to above the top of the bottom plate in the upper *storey*, and
(d) completely fills the nominal gap of 25 mm between the headers and between the wall plates.

9.10.16.4. Penetration of Fire Blocks

(1) Where *fire blocks* are pierced by pipes, ducts or other elements, the effectiveness of the *fire blocks* shall be maintained around such elements.

9.10.17. Flame Spread Limits

9.10.17.1. Flame-Spread Rating of Interior Surfaces

(1) Except as otherwise provided in this Subsection, the exposed surface of every interior wall and ceiling, including skylights and glazing, shall have a surface *flame-spread rating* of not more than 150.

(2) Except as permitted in Sentence (3), doors need not conform to Sentence (1) provided they have a surface *flame-spread rating* of not more than 200.

(3) Doors within *dwelling units*, other than vehicle garage doors, need not conform to Sentences (1) and (2).

9.10.17.10. Protection of Foamed Plastics

(1) Except as provided in Sentence (2), foamed plastics that form part of a wall or ceiling assembly in *combustible construction* shall be protected from adjacent space in the *building*, other than adjacent concealed spaces within *attic or roof spaces*, crawl spaces and wall assemblies, by,
(a) one of the finishes described in Subsections 9.29.4. to 9.29.9.,
(b) sheet metal mechanically fastened to the supporting assembly independent of the insulation and having a thickness of not less than 0.38 mm and a melting point not below 650°C provided the *building* does not contain a Group C *major occupancy*, or
(c) any thermal barrier that meets the requirements of Clause 3.1.5.12.(2)(e).

(2) Foamed plastic insulation having a *flame-spread rating* of not more than 500 is permitted to be used in factory-assembled doors in *storage garages* serving *buildings* of *residential occupancy* provided that,
(a) the insulation is covered on the interior with a metallic foil,
(b) the assembly has a surface *flame-spread rating* of not more than 200, and
(c) the assembly incorporates no air spaces.

9.10.17.11. Walls and Ceilings in Bathrooms

(1) The interior finish of walls and ceilings in bathrooms within *suites* of *residential occupancy* shall have a surface *flame-spread rating* of not more than 200.

9.10.17.12. Coverings or Linings of Ducts

(1) Where a covering or a lining is used with a duct, such lining or covering shall have a *flame-spread rating* conforming to Part 6.

9.10.19. Smoke Alarms

9.10.19.1. Required Smoke Alarms

(1) *Smoke alarms* conforming to CAN/ULC-S531, "Smoke Alarms", shall be installed in each *dwelling unit* and in each sleeping room not within a *dwelling unit.*

(2) *Smoke alarms* described in Sentence (1) shall have a visual signalling component conforming to the requirements in 18.5.3. (Light, Color and Pulse Characteristics) of NFPA 72, "National Fire Alarm and Signaling Code".

9.10.19.2. Sound Patterns of Smoke Alarms

(1) The sound patterns of *smoke alarms* shall,
(a) meet the temporal patterns of *alarm signals*, or
(b) be a combination of temporal pattern and voice relay.

9.10.19.3. Location of Smoke Alarms

(1) Within *dwelling units*, sufficient *smoke alarms* shall be installed so that,
(a) there is at least one *smoke alarm* installed on each *storey*, including *basements*, and
(b) on any *storey* of a *dwelling unit* containing sleeping rooms, a *smoke alarm* is installed,
  (i) in each sleeping room, and
  (ii) in a location between the sleeping rooms and the remainder of the *storey*, and if the sleeping rooms are served by a hallway, the *smoke alarm* shall be located in the hallway.
(See Appendix A.)

(2) A *smoke alarm* required in Sentence (1) shall be installed in conformance with CAN/ULC-S553, "Installation of Smoke Alarms".

(3) A *smoke alarm* required in Sentence (1) shall have a visual signalling component conforming to the requirements in 18.5.3. (Light, Color and Pulse Characteristics) of NFPA 72, "National Fire Alarm and Signaling Code".

(4) *Smoke alarms* required in Article 9.10.19.1. and Sentence (1) shall be installed on or near the ceiling.

9.10.19.4. Power Supply

(1) Except as provided in Sentences (2) and (3), *smoke alarms* required in Sentence 9.10.19.1.(1) shall,
(a) be installed with permanent connections to an electrical circuit,
(b) have no disconnect switch between the overcurrent device and the *smoke alarm*, and
(c) in case the regular power supply to the *smoke alarm* is interrupted, be provided with a battery as an alternative power source that can continue to provide power to the *smoke alarm* for a period of not less than 7 days in the normal condition, followed by 4 min of alarm.

(2) Where the *building* is not supplied with electrical power, *smoke alarms* are permitted to be battery operated.

(3) *Suites* of *residential occupancy* are permitted to be equipped with *smoke detectors* in lieu of *smoke alarms*, provided the *smoke detectors*,
(a) are capable of independently sounding audible signals within the individual *suites*,
(b) except as provided by Sentence (4), are installed in conformance with CAN/ULC-S524, "Installation of Fire Alarm Systems", and
(c) form part of the fire alarm system.

(4) *Smoke detectors* permitted to be installed in lieu of *smoke alarms* as provided in Sentence (3) are permitted to sound localized alarms within individual *suites*, and need not sound an alarm throughout the rest of the *building*.

9.10.19.5. Interconnection of Smoke Alarms

(1) Where more than one *smoke alarm* is required in a *dwelling unit*, the *smoke alarms* shall be wired so that the activation of one alarm will cause all alarms within the *dwelling unit* to sound.

9.10.19.6. Silencing of Smoke Alarms

(1) Except as permitted in Sentence (2), a manually operated device shall be incorporated within the circuitry of a *smoke alarm* installed in a *dwelling unit* so that the signal emitted by the *smoke alarm* can be silenced for a period of not more than 10 min, after which the *smoke alarm* will reset and sound again if the level of smoke in the vicinity is sufficient to reactuate it.

(2) *Suites* of *residential occupancy* equipped with *smoke detectors* installed to CAN/ULC-S524, "Installation of Fire Alarm Systems", which are part of the fire alarm system in lieu of *smoke alarms* as permitted in Sentence 9.10.19.4.(3), need not incorporate the manually operated device required in Sentence (1).

9.10.19.7. Instructions for Maintenance and Care

(1) Where instructions are necessary to describe the maintenance and care required for *smoke alarms* to ensure continuing satisfactory performance, they shall be posted in a location where they will be readily available to the occupants for reference.

9.10.20. Firefighting

9.10.20.3. Fire Department Access to Buildings

(1) Access for fire department equipment shall be provided to each *building* by means of a *street*, private roadway or yard. (See Appendix A.)

(2) Where access to a *building* as required in Sentence (1) is provided by means of a roadway or yard, the design and location of such roadway or yard shall take into account connection with public thoroughfares, weight of firefighting equipment, width of roadway, radius of curves, overhead clearance, location of fire hydrants, location of fire department connections and vehicular parking.

9.10.22. Fire Protection for Gas, Propane and Electric Cooktops

9.10.22.1. Installation of Ranges

(1) Reserved

(2) Clearances for and protection around gas, propane and electric ranges shall be not less than those provided in Articles 9.10.22.2. and 9.10.22.3.

9.10.22.2. Vertical Clearances Above Cooktops

(1) Except as provided in Sentence (2), framing, finishes and cabinetry installed directly above the location of the *cooktop* shall be not less than 750 mm above the level of *cooktop* burners or elements.

(2) The vertical clearance described in Sentence (1) for framing, finishes and cabinets located directly above the location of the *cooktop* is permitted to be reduced to 600 mm above the level of the elements or burners provided the framing, finishes and cabinets,
(a) are *noncombustible*, or
(b) are protected by,
  (i) asbestos millboard not less than 6 mm thick, covered with sheet metal not less than 0.33 mm thick, or
  (ii) a metal hood with a 125 mm projection beyond the framing, finishes and cabinets.

9.10.22.3. Protection Around Cooktops

(1) Except as provided in Sentences (2) and (3), *combustible* wall framing, finishes or cabinets within 450 mm of the area where the *cooktop* is to be located shall be protected above the level of the heating elements or burners by material providing fire resistance not less than that of a 9.5 mm thickness of gypsum board.

(2) Countertop splash boards or back plates that extend above the level of the heating elements or burners need not be protected as described in Sentence (1).

(3) Except for cabinetry described in Article 9.10.22.2., cabinetry located not less than 450 mm above the level of the heating elements or burners need not be protected as described in Sentence (1).

Section 9.11. Sound Control

9.11.1. Sound Transmission Class Rating (Airborne Sound)

9.11.1.1. Determination of Sound Transmission Class Ratings

(1) Sound transmission class ratings shall be determined in accordance with ASTM E413, "Classification for Rating Sound Insulation", using results from measurements in accordance with,
(a) ASTM E90, "Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements", or
(b) ASTM E336, "Measurement of Airborne Sound Attenuation Between Rooms in Buildings".
(See Appendix A.)

9.11.2. Required Sound Control Locations (Airborne Sound)

9.11.2.1. Minimum Sound Transmission Class Ratings

(1) Except as provided in Sentence (2), every *dwelling unit* and every *suite* in *hotels* shall be separated from every other space in a *building* in which noise may be generated, by an assembly providing a sound transmission class rating of at least 50, measured in accordance with Subsection 9.11.1. or as listed in Tables 1 and 2 of MMAH Supplementary Standard SB-3, "Fire and Sound Resistance of Building Assemblies".

9.11.2.2. Building Services in an Assembly

(1) *Building* services located in an assembly required to have a sound transmission class rating shall be installed in a manner that will not decrease the required rating of the assembly.

Section 9.12. Excavation

9.12.1. General

9.12.1.1. Removal of Topsoil and Organic Matter

(1) The topsoil and vegetable matter in all unexcavated areas under a *building* shall be removed.

(2) In localities where termite infestation is known to be a problem, all stumps, roots and other wood debris shall be removed from the *soil* to a depth of not less than 300 mm in unexcavated areas under a *building*.

(3) The bottom of every *excavation* shall be free of all organic material.

9.12.1.2. Standing Water

(1) *Excavations* shall be kept free of standing water.

9.12.1.3. Protection from Freezing

(1) The bottom of *excavations* shall be kept from freezing throughout the entire construction period.

9.12.1.4. Precautions During Excavation

(1) Every *excavation* shall be undertaken in such a manner to prevent damage to adjacent property, existing structures, utilities, roads and sidewalks at all stages of construction.

(2) Material shall not be placed nor shall equipment be operated or placed in or adjacent to an *excavation* in a manner that may endanger the integrity of the *excavation* or its supports.

9.12.2. Depth

9.12.2.1. Excavation to Undisturbed Soil

(1) *Excavations* for *foundations* shall extend to undisturbed *soil*.

9.12.2.2. Minimum Depth of Foundations

(1) Except as provided in Sentences (4) to (7), the minimum depth of *foundations* below finished ground level shall conform to Table 9.12.2.2.

Table 9.12.2.2.
Minimum Depths of Foundations
Forming Part of Sentence 9.12.2.2.(1)

Type of Soil	Minimum Depth of Foundation Containing Heated Basement or Crawl Space(1)		Minimum Depth of Foundation Containing no Heated Space(2)	
	Good Soil Drainage	Poor Soil Drainage	Good Soil Drainage	Poor Soil Drainage
Rock	No limit	No limit	No limit	No limit
Coarse grained soils	No limit	No limit	No limit	Below the depth of frost penetration
Silt	No limit	No limit	Below the depth of frost penetration(3)	Below the depth of frost penetration
Clay or soils not clearly defined(4)	1.2 m(3)	1.2 m	1.2 m but not less than the depth of frost penetration(3)	1.2 m but not less than the depth of frost penetration
Column 1	2	3	4	5

Notes to Table 9.12.2.2.:
(1) Foundation not insulated to reduce heat loss through the footings.
(2) Including foundations containing heated space insulated to reduce heat loss through the footings.
(3) Good soil drainage to not less than the depth of frost penetration.
(4) See Appendix A.

(2) Where a *foundation* is insulated in a manner that will reduce the heat flow to the *soil* beneath the footings, the *foundation* depth shall conform to that required for *foundations* containing no heated space. (See Appendix A.)

(3) The minimum depth of *foundations* for exterior concrete steps with more than 2 risers shall conform to Sentences (1), (2) and (5).

(4) Concrete steps with 1 and 2 risers are permitted to be laid on ground level.

(5) The *foundation* depths required in Sentence (1) are permitted to be decreased where experience with local *soil* conditions shows that lesser depths are satisfactory, or where the *foundation* is designed for lesser depths.

(6) The *foundation* depths required in Sentence (1) do not apply to *foundations* for,
(a) *buildings,*
  (i) that are not of masonry or masonry veneer construction, and
  (ii) whose superstructure conforms with the requirements of the deformation resistance test in CSA Z240.2.1, "Structural Requirements for Manufactured Homes", or
(b) accessory *buildings,*
  (i) that are not of masonry or masonry veneer construction,
  (ii) not more than 1 *storey* in *building height,*
  (iii) not more than 55 m^2 in *building area,* and
  (iv) where the distance from the finished ground to the underside of the floor joists is not more than 600 mm.

(7) The *foundation* depths required in Sentence (1) do not apply to *foundations* for decks and other accessible exterior platforms,
(a) that are of not more than 1 *storey,*
(b) that are not more than 55 m^2 in area,
(c) where the distance from the finished ground to the underside of the floor joists is not more than 600 mm,
(d) that are not supporting a roof, and
(e) that are not attached to another structure, unless it can be demonstrated that differential movement will not adversely affect the performance of that structure.

9.12.3. Backfill

9.12.3.1. Placement of Backfill

(1) Backfill shall be placed to avoid damaging the *foundation* wall, the drainage tile, drainage layer, externally applied thermal insulation, waterproofing and dampproofing of the wall.

9.12.3.2. Grading of Backfill

(1) Backfill shall be graded to prevent drainage towards the *foundation* after settling.

9.12.3.3. Deleterious Debris and Boulders

(1) Backfill within 600 mm of the *foundation* shall be free of deleterious debris and boulders larger than 250 mm diam. (See Appendix A.)

(2) Except as permitted in Sentence (3), backfill shall not contain pyritic material or material that is susceptible to ice lensing in concentrations that will damage the *building* to a degree that would adversely affect its stability or the performance of assemblies separating dissimilar environments. (See A-9.4.4.4.(1) in Appendix A.)

(3) Backfill with material of any concentration that is susceptible to ice lensing is permitted where *foundation* walls are cast-in-place concrete, concrete block insulated on the exterior or concrete block protected from the backfill by a material that serves as a slip plane. (See A-9.4.4.4.(1) in Appendix A.)

9.12.3.4. Lateral Support of Foundation Wall

(1) Where the height of *foundation* wall is such that lateral support is required, or where the required concrete strength of the wall has not been reached, the wall shall be braced or laterally supported before backfilling.

9.12.4. Trenches Beneath Footings

9.12.4.1. Compacting or Filling With Concrete

(1) The *soil* in trenches beneath footings for sewers and watermains shall be compacted by tamping up to the level of the footing base, or shall be filled with concrete having a strength not less than 10 MPa to support the footing.

Section 9.13. Dampproofing, Waterproofing and Soil Gas Control

9.13.1. General

9.13.1.1. Application

(1) This Section applies to the control of moisture and *soil* gas ingress through walls, floors, and roofs in contact with the ground.

9.13.2. Dampproofing

9.13.2.1. Dampproofing

(1) Except as provided in Article 9.13.3.1., where the exterior finished ground level is at a higher elevation than the ground level inside the *foundation* walls, exterior surfaces of *foundation* walls below ground level shall be dampproofed.

(2) Except as provided in Sentence (3) and Article 9.13.3.1., floors-on-ground shall be dampproofed.

(3) Floors in garages, floors in unenclosed portions of *buildings* and floors installed over granular *fill* in conformance with Article 9.16.2.1. need not be dampproofed.

(4) Dampproofing in Sentence (1) is not required where the exterior surfaces of *foundation* walls below ground level are waterproofed.

9.13.2.2. Material Standards

(1) Except as otherwise specified in this Section, materials used for exterior dampproofing shall conform to,
(a) CAN/CGSB-37.1-M, "Chemical Emulsified Type, Emulsified Asphalt for Dampproofing",
(b) CAN/CGSB-37.2-M, "Emulsified Asphalt, Mineral Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings",
(c) CGSB 37-GP-6Ma, "Asphalt, Cutback, Unfilled, for Dampproofing",
(d) CAN/CGSB-37.16-M, "Filled, Cutback Asphalt for Dampproofing and Waterproofing",
(e) CGSB 37-GP-18Ma, "Tar, Cutback, Unfilled, for Dampproofing",
(f) CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet, for Use in Building Construction",
(g) CAN/CSA-A123.4, "Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems," or
(h) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing".

9.13.2.3. Standards for Application

(1) The method of application of all bituminous dampproofing materials shall conform to,
(a) CAN/CGSB-37.3-M, "Application of Emulsified Asphalts for Dampproofing or Waterproofing",
(b) CGSB 37-GP-12Ma, "Application of Unfilled Cutback Asphalt for Dampproofing", or
(c) CAN/CGSB-37.22-M, "Application of Unfilled, Cutback Tar Foundation Coating for Dampproofing".

9.13.2.4. Preparation of Surface

(1) Unit masonry walls to be dampproofed shall be,
(a) parged on the exterior face below ground level with not less than 6 mm of mortar conforming to Section 9.20., and
(b) coved over the footing when the first course of block is laid.

(2) Concrete walls to be dampproofed shall have holes and recesses resulting from the removal of form ties sealed with cement mortar or dampproofing material.

(3) The surface of insulating concrete form walls to be dampproofed shall be repaired and free of projections and depressions that could be detrimental to the performance of the membrane to be applied.

9.13.2.5. Application of Dampproofing Material

(1) Dampproofing material shall be applied over the parging or concrete below ground level.

9.13.2.6. Moisture Protection for Interior Finishes (See Appendix A.)

(1) The interior surface of *foundation* walls below ground level shall be protected by means that minimize the ingress of moisture from the *foundation* wall into interior spaces where,
(a) a separate interior finish is applied to a concrete or unit masonry wall that is in contact with the *soil*, or
(b) wood members are placed in contact with such walls for the installation of insulation or finish.

(2) Except as provided in Sentence (3), where the protection of interior finishes required in Sentence (1) consists of membranes or coatings,
(a) the membrane or coating shall extend from the *basement* floor surface up to the highest extent of the interior insulation or finish, but not higher than the exterior finished ground level, and
(b) no membrane or coating with a permeance less than 170 ng/(Pa·s·m^2) shall be applied to the interior surface of the *foundation* wall above ground level between the insulation and the *foundation* wall.

(3) Where insulation functions as both moisture protection for interior finishes and as a *vapour barrier* in accordance with Subsection 9.25.4., it shall be applied over the entire interior surface of the *foundation* wall.

9.13.2.7. Dampproofing of Floors-on-Ground

(1) Where floors are dampproofed, the dampproofing shall be installed below the floor, except that where a separate floor is provided over a slab, the dampproofing is permitted to be applied to the top of the slab. (See Appendix A.)

(2) Where installed below the floor, dampproofing membranes shall consist of polyethylene not less than 0.15 mm thick, or Type S roll roofing. (See Appendix A.)

(3) Joints in dampproofing membranes described in Sentence (2) shall be lapped not less than 100 mm.

(4) Where installed above the slab, dampproofing shall consist of,
(a) no fewer than 2 mopped-on coats of bitumen,
(b) not less than 0.05 mm polyethylene, or
(c) other material providing equivalent performance.

9.13.2.8. Dampproofing of Preserved Wood Foundation Walls

(1) Preserved wood *foundation* walls shall be dampproofed as described in CAN/CSA-S406, "Construction of Preserved Wood Foundations".

9.13.3. Waterproofing

9.13.3.1. Required Waterproofing

(1) Where hydrostatic pressure occurs, waterproofing is required for exterior surfaces of,
(a) floors-on-ground, and
(b) below ground walls, where the exterior finished ground level is at a higher elevation than the ground level inside the *foundation* walls.

(2) Roofs of underground structures shall be waterproofed to prevent the entry of water into the structure.

9.13.3.2. Material Standards

(1) Except as otherwise specified in this Section, materials used for exterior waterproofing shall conform to,
(a) CAN/CGSB-37.2-M, "Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings",
(b) CAN/CGSB-37.16-M, "Filled, Cutback Asphalt for Dampproofing and Waterproofing",
(c) CAN/CSA-A123.4, "Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems", or
(d) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing".

9.13.3.3. Standards for Application

(1) The method of application of all bituminous waterproofing materials shall conform to CAN/CGSB-37.3-M, "Application of Emulsified Asphalts for Dampproofing or Waterproofing".

9.13.3.4. Preparation of Surface

(1) Unit masonry walls that are to be waterproofed shall be parged on exterior surfaces below ground level with not less than 6 mm of mortar conforming to Section 9.20.

(2) Concrete walls that are to be waterproofed shall have all holes and recesses resulting from removal of form ties sealed with mortar or waterproofing material.

(3) The surface of insulating concrete form walls that are to be waterproofed shall be repaired and free of projections and depressions that could be detrimental to the performance of the membrane to be applied.

9.13.3.5. Application of Waterproofing Membranes

(1) Concrete or unit masonry walls to be waterproofed shall be covered with no fewer than 2 layers of bitumen-saturated membrane, with each layer cemented in place with bitumen and coated overall with a heavy coating of bitumen.

9.13.3.6. Floor Waterproofing System

(1) *Basement* floors-on-ground to be waterproofed shall have a system of membrane waterproofing provided between 2 layers of concrete, each of which shall be not less than 75 mm thick, with the floor membrane mopped to the wall membrane to form a complete seal.

9.13.4. Soil Gas Control (See Appendix A.)

9.13.4.1. Soil Gas Control

(1) Where methane or radon gases are known to be a problem, construction shall comply with the requirements for *soil* gas control in MMAH Supplementary Standard SB-9, "Requirements for Soil Gas Control".

9.13.4.2. Required Soil Gas Control

(1) Except as provided in Sentence (2), all wall, roof and floor assemblies in contact with the ground shall be constructed to resist the leakage of *soil* gas from the ground into the *building*.

(2) Construction to resist leakage of *soil* gas into the *building* is not required for,
(a) garages and unenclosed portions of *buildings*,
(b) *buildings* constructed in areas where it can be demonstrated that *soil* gas does not constitute a hazard, or
(c) *buildings* that contain a single *dwelling unit* and are constructed to provide for subfloor depressurization in accordance with MMAH Supplementary Standard SB-9, "Requirements for Soil Gas Control".

(3) Where *soil* gas control is required, a *soil* gas barrier shall be installed at walls and roofs in contact with the ground according to MMAH Supplementary Standard SB-9, "Requirements for Soil Gas Control".

(4) Where *soil* gas control is required, it shall consist of one of the following at floors in contact with the ground:
(a) a *soil* gas barrier installed according to MMAH Supplementary Standard SB-9, "Requirements for Soil Gas Control", or
(b) where the *building* contains a single *dwelling unit* only, a subfloor depressurization system installed according to MMAH Supplementary Standard SB-9, "Requirements for Soil Gas Control".

9.13.4.3. Material Standards

(1) Materials used to provide a barrier to *soil* gas ingress through floors-on-ground shall conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet, for Use in Building Construction".

Section 9.14. Drainage

9.14.1. Scope

9.14.1.1. Application

(1) This Section applies to subsurface drainage and to surface drainage.

9.14.1.2. Crawl Spaces

(1) Drainage for crawl spaces shall conform to Section 9.18.

9.14.1.3. Floors-on-Ground

(1) Drainage requirements beneath floors-on-ground shall conform to Section 9.16.

9.14.2. Foundation Drainage

9.14.2.1. Foundation Wall Drainage

(1) Unless it can be shown to be unnecessary, drainage shall be provided at the bottom of every *foundation* wall that contains the *building* interior.

(2) Except as provided in Sentences (4) and (5), where the insulation on a *foundation* wall extends to more than 900 mm below the adjacent exterior ground level,
(a) a drainage layer shall be installed adjacent to the exterior surface of a *foundation* wall consisting of,
  (i) not less than 19 mm mineral fibre insulation with a density of not less than 57 kg/m^3, or
  (ii) not less than 100 mm of free draining granular material, or
(b) a system shall be installed that can be shown to provide equivalent performance to that provided by the materials described in Clause (a).
(See Appendix A.)

(3) Where mineral fibre insulation, crushed rock backfill or other drainage layer medium is provided adjacent to the exterior surface of a *foundation* wall,
(a) the insulation, backfill or other drainage layer medium shall extend to the footing level to facilitate drainage of ground water to the *foundation* drainage system, and
(b) any pyritic material in the crushed rock shall be limited to a concentration that will not damage the *building* to a degree that would adversely affect its stability or the performance of assemblies separating dissimilar environments.

(4) Except when the insulation provides the drainage layer required in Clause (2)(a), when exterior insulation is provided, the drainage layer shall be installed on the exterior face of the insulation.

(5) The drainage layer required in Sentence (2) is not required,
(a) when the *foundation* wall is not required to be dampproofed, or
(b) when the *foundation* wall is waterproofed.

(6) Where drainage is required in Sentence (1), the drainage shall conform to Subsection 9.14.3. or 9.14.4.

9.14.3. Drainage Tile and Pipe

9.14.3.1. Material Standards

(1) Drain tile and drain pipe for *foundation* drainage shall conform to,
(a) ASTM C4, "Clay Drain Tile and Perforated Clay Drain Tile",
(b) ASTM C412M, "Concrete Drain Tile (Metric)",
(c) ASTM C444M, "Perforated Concrete Pipe (Metric)",
(d) ASTM C700, "Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated",
(e) CAN/CGSB-34.22, "Asbestos-Cement Drain Pipe",
(f) CAN/CSA-B182.1, "Plastic Drain and Sewer Pipe and Pipe Fittings",
(g) CAN/CSA-G401, "Corrugated Steel Pipe Products", or
(h) BNQ 3624-115, "Polyethylene (PE) Pipe Fittings – Flexible Pipes for Drainage – Characteristics and Test Methods".

9.14.3.2. Minimum Size

(1) Drain tile or pipe used for *foundation* drainage shall be not less than 100 mm in diam.

9.14.3.3. Installation

(1) Drain tile or pipe shall be laid on undisturbed or well-compacted *soil* so that the top of the tile or pipe is below the bottom of the floor slab or the ground cover of the crawl space.

(2) Drain tile or pipe with butt joints shall be laid with 6 mm to 10 mm open joints.

(3) The top half of joints referred to in Sentence (2) shall be covered with sheathing paper, 0.10 mm polyethylene or No. 15 asphalt or tar-saturated felt.

(4) The top and sides of drain pipe or tile shall be covered with not less than 150 mm of crushed stone or other coarse clean granular material containing not more than 10% of material that will pass a 4 mm sieve.

9.14.4. Granular Drainage Layer

9.14.4.1. Type of Granular Material

(1) Granular material used to drain the bottom of a *foundation* shall consist of a continuous layer of crushed stone or other coarse clean granular material containing,
(a) not more than 10% of material that will pass a 4 mm sieve, and
(b) no pyritic material in a concentration that would adversely affect its stability or the performance of assemblies separating dissimilar environments.

9.14.4.2. Installation

(1) Granular material described in Article 9.14.4.1. shall be laid on undisturbed or compacted *soil* to a minimum depth of not less than 125 mm beneath the footing of the *building* and extend not less than 300 mm beyond the outside edge of the footings.

9.14.4.3. Grading

(1) The bottom of an *excavation* drained by a granular layer shall be graded so that the entire area described in Article 9.14.4.2. is drained to a sump conforming to Article 9.14.5.2.

9.14.4.4. Wet Site Conditions

(1) Where because of wet site conditions *soil* becomes mixed with the granular drainage material, sufficient additional granular material shall be provided so that the top 125 mm is kept free of *soil*.

9.14.5. Drainage Disposal

9.14.5.1. Drainage Disposal

(1) *Foundation* drains shall drain to a sewer, drainage ditch or dry well.

9.14.5.2. Sump Pits

(1) Where gravity drainage is not practical, a covered sump with an automatic pump shall be installed to discharge the water into a sewer, drainage ditch or dry well.

(2) Covers for sump pits shall be,
(a) designed to resist removal by children, and
(b) sealed in accordance with Sentence 9.25.3.3.(16).

9.14.5.3. Dry Wells

(1) Dry wells are permitted to be used only when located in areas where the natural *groundwater* level is below the bottom of the dry well.

(2) Dry wells shall be not less than 5 m from the *building foundation* and located so that drainage is away from the *building*.

9.14.6. Surface Drainage

9.14.6.1. Surface Drainage

(1) The *building* shall be located or the *building* site graded so that water will not accumulate at or near the *building* and will not adversely affect adjacent properties.

9.14.6.2. Drainage away from Wells or Leaching Beds

(1) Surface drainage shall be directed away from the location of a water supply well or *leaching bed*.

9.14.6.3. Window Wells

(1) Every window well shall be drained to the footing level or other suitable location.

9.14.6.4. Catch Basin

(1) Where runoff water from a driveway is likely to accumulate or enter a garage, a catch basin shall be installed to provide adequate drainage.

9.14.6.5. Downspouts

(1) Downspouts shall conform to Article 9.26.18.2.

Section 9.15. Footings and Foundations

9.15.1. Application

9.15.1.1. General (See Appendix A and A-9.4.4.6.)

(1) Except as provided in Articles 9.15.1.2. and 9.15.1.3., this Section applies to,
(a) concrete or unit masonry *foundation* walls and concrete footings not subject to surcharge,
  (i) on stable *soils* with an *allowable bearing pressure* of 75 kPa or greater, and
  (ii) for *buildings* of wood frame or masonry construction,
  (b) wood frame *foundation* walls and wood or concrete footings not subject to surcharge,
  (i) on stable *soils* with an *allowable bearing pressure* of 75 kPa or greater, and
  (ii) for *buildings* of wood frame construction, and
(c) flat insulating concrete form *foundation* walls and concrete footings not subject to surcharge,
  (i) on stable *soils* with an *allowable bearing pressure* of 75 kPa or greater, and
  (ii) for *buildings* of light frame or flat insulating concrete form construction that are not more than 2 *storeys* in *building height*, with a maximum floor to floor height of 3 m, and containing only a single *dwelling unit*.
(See Appendix A.)

(2) *Foundations* for applications other than as described in Sentence (1) shall be designed in accordance with Section 9.4.

(3) Where a *foundation* is erected on filled ground, peat or sensitive clay, the footing sizes shall be designed in conformance with Section 4.2.

(4) For the purpose of Sentence (3), sensitive clay means the grain size of the majority of the particles is smaller than 0.002 mm, including leda clay.

9.15.1.2. Permafrost

(1) *Buildings* erected on permafrost shall have *foundations* designed by a *designer* competent in this field in accordance with the appropriate requirements of Part 4.

9.15.1.3. Foundations for Deformation Resistant Buildings

(1) Where the superstructure of a detached *building* conforms to the requirements of the deformation resistance test in CSA Z240.2.1, "Structural Requirements for Manufactured Homes", the *foundation* shall be constructed in conformance with,
(a) this Section, or
(b) CSA Z240.10.1, "Site Preparation, Foundation, and Anchorage of Manufactured Homes".

9.15.2. General

9.15.2.1. Concrete

(1) Concrete shall conform to Section 9.3.

9.15.2.2. Unit Masonry Construction

(1) Concrete block shall conform to CAN/CSA-A165.1, "Concrete Block Masonry Units", and shall have a compressive strength over the average net cross-sectional area of the block of not less than 15 MPa.

(2) Mortar, grout, mortar joints, corbelling and protection for unit masonry shall conform to Section 9.20.

(3) For concrete block *foundation* walls required to be reinforced,
(a) mortar shall be Type S, conforming to CAN/CSA-A179, "Mortar and Grout for Unit Masonry",
(b) grout shall be coarse, conforming to CAN/CSA-A179, "Mortar and Grout for Unit Masonry", and
(c) placement of grout shall conform to CAN/CSA-A371, "Masonry Construction for Buildings".

9.15.2.3. Pier Type Foundations

(1) Where pier type *foundations* are used, the piers shall be designed to support the applied loads from the superstructure.

(2) Where piers are used as a *foundation* system in a *building* of 1 *storey* in *building height*, the piers shall be installed to support the principal framing members and shall be spaced not more than 3.5 m apart along the framing, unless the piers and their footings are designed for larger spacings.

(3) The height of piers described in Sentence (2) shall not exceed 3 times their least dimension at the base of the pier.

(4) Where concrete block is used for piers described in Sentence (2), they shall be laid with cores placed vertically, and where the width of the *building* is 4.3 m or less, placed with their longest dimension at right angles to the longest dimension of the *building*.

9.15.2.4. Wood Frame Foundations

(1) *Foundations* of wood frame construction shall conform to,
(a) CAN/CSA-S406, "Construction of Preserved Wood Foundations", or
(b) Part 4.
(See Appendix A.)

9.15.3. Footings

9.15.3.1. Footings Required

(1) Footings shall be provided under walls, pilasters, columns, piers, fireplaces and *chimneys* that bear on *soil* or *rock*, except that footings are permitted to be omitted under piers or monolithic concrete walls if the safe *loadbearing* capacity of the *soil* or *rock* is not exceeded.

9.15.3.2. Support of Footings

(1) Footings shall rest on undisturbed *soil*, *rock* or compacted granular *fill*.

(2) Granular *fill* shall not contain pyritic material in a concentration that would adversely affect its stability or the performance of assemblies separating dissimilar environments.

9.15.3.3. Application of Footing Width and Area Requirements

(1) Except as provided in Sentence 9.15.3.4.(2), the minimum footing width or area requirements provided in Articles 9.15.3.4. to 9.15.3.7. shall apply to footings where,
(a) the footings support,
  (i) *foundation* walls of masonry, concrete, or flat insulating concrete form walls,
  (ii) above ground walls of masonry, flat insulating concrete form walls or light wood frame construction, and
  (iii) floors and roofs of light wood frame construction,
(b) the span of supported joists does not exceed 4.9 m, and
(c) the specified *live load* on any floor supported by the footing does not exceed 2.4 kPa.

(2) Except as provided in Sentence 9.15.3.4.(2), where the span of the supported joists exceeds 4.9 m, footings shall be designed in accordance with Section 4.2.

(3) Where the specified *live load* exceeds 2.4 kPa footings shall be designed in accordance with Section 4.2.

9.15.3.4. Basic Footing Widths and Areas

(1) Except as provided in Sentences (2) and (3) and in Articles 9.15.3.5. to 9.15.3.7., the minimum footing width or area shall comply with Table 9.15.3.4.

Table 9.15.3.4.
Minimum Footing Sizes
Forming Part of Sentence 9.15.3.4.(1)

Number of Floors Supported	Minimum Width of Strip Footings, mm		Minimum Footing Area for Columns Spaced 3 m o.c.[(1)], m^2
	Supporting Exterior Walls[(2)]	Supporting Interior Walls[(3)]	
1	250	200	0.40
2	350	350	0.75
3	450	500	1.0
Column 1	2	3	4

Notes to Table 9.15.3.4.:
(1) See Sentence 9.15.3.7.(1).
(2) See Sentences 9.15.3.5.(1).
(3) See Sentence 9.15.3.6.(1).

(2) Where the supported joist span exceeds 4.9 m in *buildings* with light wood frame walls, floors and roofs, footing widths shall be determined according to,
(a) Section 4.2., or
(b) the following formula:

$$W = w \bullet [\, \Sigma\, sjs / (storeys \bullet 4.9)]$$

where,

W = minimum footing width,

w = minimum width of footings supporting joists not exceeding 4.9 m, as defined by Table 9.15.3.4.,

Σ sjs = the sum of the supported joist spans on each *storey* whose load is transferred to the footing, and

storeys = number of *storeys* supported by the footing.

(See Appendix A.)

(3) Where a *foundation* rests on gravel, sand or silt in which the water table level is less than the width of the footings below the *bearing surface*,
(a) the footing width for walls shall be not less than twice the width required by Sentences (1) and (2), and Articles 9.15.3.5. and 9.15.3.6., and
(b) the footing area for columns shall be not less than twice the area required by Sentences (1) and (2), and Article 9.15.3.7.

9.15.3.5. Adjustments to Footing Widths for Exterior Walls

(1) The strip footing widths for exterior walls shown in Table 9.15.3.4. shall be increased by,
(a) 65 mm for each *storey* of masonry veneer over wood frame construction supported by the *foundation* wall,
(b) 130 mm for each *storey* of masonry construction supported by the *foundation* wall, and
(c) 150 mm for each *storey* of flat insulating concrete form wall construction supported by the *foundation* wall.

9.15.3.6. Adjustments to Footing Widths for Interior Walls

(1) The minimum strip footing widths for interior *loadbearing* masonry walls shown in Table 9.15.3.4. shall be increased by 100 mm for each *storey* of masonry construction supported by the footing.

(2) Footings for interior non-*loadbearing* masonry walls shall be not less than 200 mm wide for walls up to 5.5 m high and the width shall be increased by 100 mm for each additional 2.7 m of height.

9.15.3.7. Adjustments to Footing Area for Columns

(1) The footing area for column spacings other than shown in Table 9.15.3.4. shall be adjusted in proportion to the distance between columns.

9.15.3.8. Footing Thickness

(1) Footing thickness shall be not less than the greater of,
(a) 100 mm, or
(b) the width of the projection of the footing beyond the supported element.

9.15.3.9. Step Footings

(1) Where step footings are used,
(a) the vertical rise between horizontal portions shall not exceed 600 mm, and
(b) the horizontal distance between risers shall be not less than 600 mm.

9.15.4. Foundation Walls

9.15.4.1. Permanent Form Material

(1) Insulating concrete form units shall be manufactured of polystyrene conforming to the performance requirements of CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering", for Type 2, 3 or 4 polystyrene.

9.15.4.2. Foundation Wall Thickness and Required Lateral Support

(1) Except as required in Sentence (2), the thickness of *foundation* walls made of unreinforced concrete block or solid concrete and subject to lateral earth pressure shall conform to Table 9.15.4.2.A. for walls not exceeding 3.0 m in unsupported height.

Table 9.15.4.2.A.
Thickness of Solid Concrete and Unreinforced Concrete Block Foundation Walls
Forming Part of Sentence 9.15.4.2.(1)

Type of Foundation Wall	Minimum Wall Thickness, mm	Maximum Height of Finish Ground Above Basement Floor or Crawl Space Ground Cover, m			
		Height of Foundation Wall Laterally Unsupported at the Top(1)(2)	Height of Foundation Wall Laterally Supported at the Top(1)(2)		
		≤ 3.0 m	≤ 2.5 m	> 2.5 m and ≤ 2.75 m	> 2.75 m and ≤ 3.0 m
Solid concrete, 15 MPa min. strength	150	0.8	1.5	1.5	1.4
	200	1.2	2.15	2.15	2.1
	250	1.4	2.3	2.6	2.5
	300	1.5	2.3	2.6	2.85
Solid concrete, 20 MPa min. strength	150	0.8	1.8	1.6	1.6
	200	1.2	2.3	2.3	2.2
	250	1.4	2.3	2.6	2.85
	300	1.5	2.3	2.6	2.85
Unreinforced concrete block	140	0.6	0.8	—	—
	190	0.9	1.2	(3)	(3)
	240	1.2	1.8	(3)	(3)
	290	1.4	2.2	—	—
Column 1	2	3	4	5	6

Notes to Table 9.15.4.2.A.:
(1) See Article 9.15.4.3.
(2) See Article 9.15.4.6.
(3) See Table 9.15.4.2.B.

(2) The thickness of concrete in flat insulating concrete form *foundation* walls shall be not less than the greater of,
(a) 140 mm, or
(b) the thickness of the concrete in the wall above.

(3) *Foundation* walls made of flat insulating concrete form units shall be laterally supported at the top and at the bottom.

(4) The thickness and reinforcing of *foundation* walls made of reinforced concrete block and subject to lateral earth pressure shall conform to Table 9.15.4.2.B. and Sentences (5) to (8) where,
(a) the walls are laterally supported at the top,
(b) average stable *soils* are encountered, and
(c) wind loads on the exposed portion of the *foundation* are no greater than 0.70 kPa.

(5) For concrete block walls required to be reinforced, continuous vertical reinforcement shall,
(a) be provided at wall corners, wall ends, wall intersections, at changes in wall height, at the jambs of all openings and at movement joints,
(b) extend from the top of the footing to the top of the *foundation* wall, and
(c) where *foundation* walls are laterally supported at the top, have not less than 50 mm embedment into the footing, if the floor slab does not provide lateral support at the wall base.

Table 9.15.4.2.B.
Reinforced Concrete Block Foundation Walls Laterally Supported at the Top[(1)]
Forming Part of Sentence 9.15.4.2.(4)

Maximum Height of Finished Ground Above Basement Floor or Crawl Space Ground Cover, m[(2)]	Size and Spacing of Continuous Vertical Reinforcement, M at mm o.c.					
	190 mm Minimum Wall Thickness			240 mm Minimum Wall Thickness		
	Foundation Wall Height			Foundation Wall Height		
	≤ 2.5 m	≤ 2.75 m	≤ 3.0 m	≤ 2.5 m	≤ 2.75 m	≤ 3.0 m
0.8	(3)	(3)	(3)	(3)	(3)	(3)
1.0	(3)	1-15M at 1 800	1-15M at 1 800	(3)	(3)	(3)
1.2	(3)	1-15M at 1 600	1-15M at 1 600	(3)	1-20M at 2 000	1-20M at 2 000
1.4	1-15M at 1 600	1-15M at 1 600	1-15M at 1 600	(3)	1-20M at 1 800	1-20M at 1 800
1.6	1-15M at 1 400	1-15M at 1 400	1-15M at 1 400	(3)	1-20M at 1 600	1-20M at 1 600
1.8	1-15M at 1 400	1-15M at 1 400	1-15M at 1 200	(3)	1-20M at 1 600	1-20M at 1 600
2.0	1-15M at 1 200	1-15M at 1 000 or 1-20M at 1 200	2-15M at 1 200	1-20M at 1 600	1-20M at 1 600	1-20M at 1 600
2.2	2-15M at 1 200	2-15M at 1 000	2-15M at 1 000	1-20M at 1 400	1-20M at 1 400	1-20M at 1 400
2.4	2-15M at 1 000	2-15M at 1 000	2-15M at 800	1-20M at 1 400	1-20M at 1 400	1-20M at 1 200
2.6	N/A	2-15M at 800 or 1-25M at 1 000	2-15M at 800 or 1-25M at 1 000	N/A	1-20M at 1 000	1-20M at 1 000
2.8	N/A	N/A	1-20M at 600	N/A	N/A	1-20M at 800 or 2-15M at 1 000
3.0	N/A	N/A	1-20M at 400 or 1-25M at 600	N/A	N/A	2-15M at 800
Column 1	2	3	4	5	6	7

Notes to Table 9.15.4.2.B.:
(1) See Article 9.15.4.3.
(2) See Article 9.15.4.6.
(3) No reinforcement required.

(6) For concrete block walls required to be reinforced, a continuous horizontal bond beam containing at least one 15M bar shall be installed,
(a) along the top of the wall,
(b) at the sill and head of all openings greater than 1.2 m in width, and
(c) at structurally connected floors.

(7) In concrete block walls required to be reinforced, all vertical bar reinforcement shall be installed along the centre line of the wall.

(8) In concrete block walls required to be reinforced, ladder or truss type lateral reinforcement not less than 3.8 mm in diameter (No. 9 ASWG) shall be installed in the bed joint of every second masonry course.

9.15.4.3. Foundation Walls Considered to be Laterally Supported at the Top

(1) Sentences (2) to (4) apply to lateral support for walls described in Sentence 9.15.4.2.(1).

(2) *Foundation* walls shall be considered to be laterally supported at the top if,
(a) such walls support solid masonry superstructure,
(b) the floor joists are embedded in the top of the *foundation* walls, or
(c) the floor system is anchored to the top of the *foundation* walls with anchor bolts, in which case the joists may run either parallel or perpendicular to the *foundation* walls.

(3) Unless the wall around an opening is reinforced to withstand earth pressure, the portion of the *foundation* wall beneath an opening shall be considered laterally unsupported, if,
(a) the opening is more than 1.2 m wide, or
(b) the total width of the openings in the *foundation* wall constitutes more than 25% of the length of the wall.

(4) For the purposes of Sentence (3), the combined width of the openings shall be considered as a single opening if the average width is greater than the width of solid wall between them.

(5) Flat insulating concrete form *foundation* walls shall be considered to be laterally supported at the top if the floor joists are installed according to Article 9.20.17.5.

9.15.4.4. Foundation Walls Considered to be Laterally Supported at the Bottom

(1) Flat insulating concrete form *foundation* walls shall be considered to be laterally supported at the bottom where the *foundation* wall,
(a) supports backfill not more than 1.2 m in height,
(b) is supported at the footing by a shear key and is supported at the top by the ground floor framing, or
(c) is dowelled to the footing with not less than 15M bars spaced not more than 1.2 m o.c.

9.15.4.5. Reinforcement for Flat Insulating Concrete Form Foundation Walls

(1) Horizontal reinforcement in flat insulating concrete form *foundation* walls shall,
(a) consist of,
  (i) one 10M bar placed not more than 300 mm from the top of the wall, and
  (ii) 10M bars spaced not more than 600 mm o.c., and
(b) be located,
  (i) in the inside half of the wall section, and
  (ii) with a minimum cover of 30 mm from the inside face of the concrete.

(2) Vertical wall reinforcement in flat insulating concrete form *foundation* walls shall,
(a) conform to,
  (i) Table 9.15.4.5.A. for 140 mm walls,

(ii) Table 9.15.4.5.B. for 190 mm walls, and
(iii) Table 9.15.4.5.C. for 240 mm walls,

(b) be located in the inside half of the wall section with a minimum cover of 30 mm from the inside face of the concrete wall, and
(c) where interrupted by wall openings, be placed not more than 600 mm from each side of the openings.

(3) Cold joints in flat insulating concrete form *foundation* walls shall be reinforced with at least one 15M bar spaced not more than 600 mm o.c. and embedded not less than 300 mm on both sides of the joint.

(4) Reinforcing around openings in flat insulating concrete form *foundation* walls shall comply with Article 9.20.17.3. or 9.20.17.4.

Table 9.15.4.5.A.
Vertical Reinforcement for 140 mm Flat Insulating Concrete Form Foundation Walls
Forming Part of Sentence 9.15.4.5.(2)

Maximum Height of Finished Ground Above Finished Basement Floor, m	Minimum Vertical Reinforcement		
	Maximum Unsupported Basement Wall Height		
	2.44 m	2.75 m	3.00 m
1.35	10M at 400 mm o.c.	10M at 400 mm o.c.	10M at 400 mm o.c.
1.60	10M at 400 mm o.c.	10M at 380 mm o.c.	10M at 380 mm o.c.
2.00	10M at 380 mm o.c.	10M at 380 mm o.c.	10M at 380 mm o.c.
2.20	10M at 250 mm o.c.	10M at 250 mm o.c.	10M at 250 mm o.c.
2.35	n/a	10M at 250 mm o.c.	10M at 250 mm o.c.
2.60	n/a	10M at 250 mm o.c.	10M at 250 mm o.c.
3.00	n/a	n/a	10M at 250 mm o.c.
Column 1	2	3	4

Table 9.15.4.5.B.
Vertical Reinforcement for 190 mm Flat Insulating Concrete Form Foundation Walls
Forming Part of Sentence 9.15.4.5.(2)

Maximum Height of Finished Ground Above Finished Basement Floor, m	Minimum Vertical Reinforcement		
	Maximum Unsupported Basement Wall Height		
	2.44 m	2.75 m	3.00 m
2.20	none required	10M at 400 mm o.c.	10M at 400 mm o.c.
2.35	n/a	10M at 300 mm o.c.	10M at 300 mm o.c.
2.60	n/a	10M at 300 mm o.c.	15M at 400 mm o.c.
3.00	n/a	n/a	15M at 400 mm o.c.
Column 1	2	3	4

Table 9.15.4.5.C.
Vertical Reinforcement for 240 mm Flat Insulating Concrete Form Foundation Walls
Forming Part of Sentence 9.15.4.5.(2)

Maximum Height of Finished Ground Above Finished Basement Floor, m	Minimum Vertical Reinforcement		
	Maximum Unsupported Basement Wall Height		
	2.44 m	2.75 m	3.00 m
2.20	none required	none required	none required
2.60	n/a	15M at 400 mm o.c.	15M at 400 mm o.c.
3.00	n/a	n/a	15M at 400 mm o.c.
Column 1	2	3	4

9.15.4.6. Extension Above Ground Level

(1) Exterior *foundation* walls shall extend not less than 150 mm above finished ground level.

9.15.4.7. Reduction in Thickness

(1) Where the top of a *foundation* wall is reduced in thickness to permit the installation of floor joists, the reduced section shall be not more than 350 mm high and not less than 90 mm thick.

(2) Where the top of a *foundation* wall is reduced in thickness to permit the installation of a masonry exterior facing, the reduced section shall be,
(a) not less than 90 mm thick, and
(b) tied to the facing material with metal ties conforming to Sentence 9.20.9.4.(3) spaced not more than,
  (i) 200 mm o.c. vertically, and
  (ii) 900 mm o.c. horizontally.

(3) The space between wall and facing described in Sentence (2) shall be filled with mortar.

9.15.4.8. Corbelling

(1) Corbelling of masonry *foundation* walls supporting *cavity walls* shall conform to Article 9.20.12.2.

9.15.4.9. Crack Control Joints

(1) Crack control joints shall be provided in *foundation* walls more than 25 m long at intervals of not more than 15 m.

(2) Joints required in Sentence (1) shall be designed to resist moisture penetration and shall be keyed to prevent relative displacement of the wall portions adjacent to the joint.

9.15.4.10. Interior Masonry Walls

(1) Interior masonry *foundation* walls not subject to lateral earth pressure shall conform to Section 9.20.

9.15.5. Support of Joists and Beams on Masonry Foundation Walls

9.15.5.1. Support of Floor Joists (See Appendix A.)

(1) Except as permitted in Sentence (2), *foundation* walls of hollow unit masonry supporting floor joists shall be,
(a) capped with not less than 50 mm of solid masonry or concrete, or
(b) have the top course filled with mortar or concrete.

(2) Capping required in Sentence (1) is permitted to be omitted,
(a) in localities where termites are not known to occur,
(b) when the joists are supported on a wood plate not less than 38 mm by 89 mm, and
(c) when the siding overlaps the *foundation* wall not less than 12 mm.

9.15.5.2. Support of Beams

(1) Not less than a 190 mm depth of solid masonry shall be provided beneath beams supported on masonry.

(2) Where the beam referred to in Sentence (1) is supported below the top of the *foundation* walls, the ends of such beams shall be protected from the weather.

9.15.5.3. Pilasters

(1) Pilasters shall be provided under beams that frame into unit masonry *foundation* walls 140 mm or less in thickness.

(2) Pilasters required in Sentence (1) shall be not less than 90 mm by 290 mm and shall be bonded or tied into the wall.

(3) The top 200 mm of pilasters required in Sentence (1) shall be solid.

9.15.6. Parging and Finishing of Foundation Walls

9.15.6.1. Foundation Walls Below Ground

(1) Concrete block *foundation* walls shall be parged on the exterior face below ground level as required in Section 9.13.

9.15.6.2. Foundation Walls Above Ground

(1) Exterior surfaces of concrete block *foundation* walls above ground level shall have tooled joints, or shall be rendered, parged or otherwise suitably finished.

9.15.6.3. Form Ties

(1) All form ties shall be removed at least flush with the concrete surface.

Section 9.16. Floors-on-Ground

9.16.1. Scope

9.16.1.1. Application

(1) This Section applies to floors that are supported on ground or granular *fill* and that do not provide structural support for the superstructure.

9.16.1.2. Structural Floor Slabs

(1) Floors-on-ground that support loads from the superstructure shall be designed in conformance with Part 4.

9.16.1.3. Required Floors-on-Ground

(1) All spaces within *dwelling units*, except crawl spaces, shall be provided with a floor-on-ground, where,
(a) access is provided to the space, and
(b) a floor supported by the structure is not provided.

9.16.1.4. Dampproofing and Waterproofing

(1) Dampproofing and waterproofing shall conform to Section 9.13.

9.16.2. Material Beneath Floors

9.16.2.1. Required Installation of Granular Fill

(1) Except as provided in Sentence (2), not less than 100 mm of coarse clean granular material containing not more than 10% of material that will pass a 4 mm sieve shall be placed beneath floors-on-ground.

(2) Granular material need not be installed under,
(a) slabs in garages, carports or accessory *buildings*

9.16.2.2. Support of Floors

(1) Material that is susceptible to changes in volume due to variations in moisture content or chemical-microbiological oxidation shall not be used as *fill* beneath floors-on-ground in a concentration that will damage the *building* to a degree that would adversely affect its stability or the performance of assemblies separating dissimilar environments.

(2) Material that is susceptible to changes in volume due to freezing shall not be used as *fill* beneath floors-on-ground that will be subjected to freezing temperatures.

(3) Except as provided in Sentence (4), *fill* beneath floors-on-ground shall be compacted.

(4) *Fill* beneath floors-on-ground need not be compacted where the material is clean coarse aggregate containing not more than 10% of material that will pass a 4 mm sieve.

9.16.3. Drainage

9.16.3.1. Control of Water Ingress

(1) Except as provided in Article 9.16.3.2. or where it can be shown to be unnecessary, ingress of water underneath a floor-on-ground shall be prevented by grading or drainage.

9.16.3.2. Hydrostatic Pressure

(1) Where *groundwater* levels may cause hydrostatic pressure beneath a floor-on-ground, the floor-on-ground shall be,
(a) a cast-in-place concrete slab, and
(b) designed to resist such pressures.

9.16.3.3. Floor Drains

(1) When floor drains are required, the floor surface shall be sloped so that no water can accumulate.

9.16.4. Concrete

9.16.4.1. Surface Finish

(1) The finished surface of concrete floor slabs shall be trowelled smooth and even.

(2) Dry cement shall not be added to the floor surfaces to absorb surplus water.

9.16.4.2. Topping Course

(1) Where a topping course is provided for a concrete floor slab, it shall consist of 1 part cement to 2.5 parts clean, well graded sand by volume, with a water/cement ratio approximately equal to that of the base slab.

(2) When concrete topping is provided it shall not be less than 20 mm thick.

9.16.4.3. Thickness

(1) Concrete slabs shall be not less than 75 mm thick exclusive of concrete topping. (See Appendix A.)

9.16.4.4. Bond Break

(1) A bond-breaking material shall be placed between the slab and footings or *rock*.

9.16.4.5. Compressive Strength

(1) Where dampproofing is not provided, the concrete used for floors-on-ground shall have a compressive strength of not less than 25 MPa after 28 days.

(2) Where dampproofing is provided as described in Article 9.13.2.7., the concrete used for floors-on-ground shall have a compressive strength of not less than 15 MPa after 28 days.

9.16.5. Wood

9.16.5.1. Wood Frame Floors

(1) Floors-on-ground constructed of wood shall conform to CAN/CSA-S406, "Construction of Preserved Wood Foundations".

Section 9.17. Columns

9.17.1. Scope

9.17.1.1. Application

(1) This Section applies to columns used to support,
(a) beams carrying loads from not more than 2 wood frame floors where,
  (i) the supported length of joists bearing on such beams does not exceed 5 m, and
  (ii) the *live load* on any floor does not exceed 2.4 kPa,
(b) beams or header joists carrying loads from not more than 2 levels of wood frame balconies, decks or other accessible exterior platforms, or 1 level and the roof, where,
  (i) the supported length of joists bearing on such beams or joists does not exceed 5 m,
  (ii) the sum of the specified snow load and the load due to use and *occupancy* does not exceed 4.8 kPa, and
  (iii) the platform serves only a single *suite* of *residential occupancy*, or
(c) carport roofs.

(2) Columns for applications other than as described in Sentence (1) shall be designed in accordance with Part 4.

9.17.2. General

9.17.2.1. Location

(1) Columns shall be centrally located on a footing conforming to Section 9.15.

9.17.2.2. Lateral Support

(1) Columns shall be securely fastened to the supported member to reduce the likelihood of lateral differential movement between the column and the supported member.

(2) Except as permitted by Sentence (3), columns shall be laterally supported,
(a) directly, or
(b) by connection to the supported members.
(See Appendix A.)

(3) Columns need not be provided with lateral support as described in Sentence (2) where,
(a) the length of the columns are not more than 600 mm measured from the finished ground to the underside of the supported member, and
(b) the columns support a deck with no superstructure.

9.17.3. Steel Columns

9.17.3.1. Size and Thickness

(1) Except as permitted by Sentence (2), steel pipe columns shall have an outside diameter of not less than 73 mm and a wall thickness of not less than 4.76 mm.

(2) Columns of sizes other than as specified in Sentence (1) are permitted to be used where the *loadbearing* capacities are shown to be adequate.

9.17.3.2. End Bearing Plates

(1) Except as permitted in Sentence (2), steel columns shall be fitted with not less than 100 mm by 100 mm by 6.35 mm thick steel plates at each end, and where the column supports a wooden beam, the top plate shall extend across the full width of the beam.

(2) The top plate required in Sentence (1) need not be provided where a column supports a steel beam and provision is made for the attachment of the column to the beam.

9.17.3.3. Paint

(1) Exterior steel columns susceptible to corrosion shall be treated on the outside surface with at least one coat of rust-inhibitive paint.

9.17.3.4. Design of Adjustable Steel Columns (See Appendix A.)

(1) Where the imposed load does not exceed 36 kN, adjustable steel columns shall conform to CAN/CGSB-7.2, "Adjustable Steel Columns".

(2) Adjustable steel columns other than those described in Sentence (1) shall be designed in accordance with Part 4.

9.17.4. Wood Columns

9.17.4.1. Column Sizes

(1) The width or diameter of a wood column shall be not less than the width of the supported member.

(2) Except as provided in Article 9.35.4.2., columns shall be not less than 184 mm for round columns and 140 mm by 140 mm for rectangular columns, unless calculations are provided to show that lesser sizes are adequate.

9.17.4.2. Materials

(1) Wood columns shall be either solid, glue-laminated or built-up.

(2) Built-up columns shall consist of not less than 38 mm thick full-length members,
(a) bolted together with not less than 9.52 mm diam bolts spaced not more than 450 mm o.c., or
(b) nailed together with not less than 76 mm nails spaced not more than 300 mm o.c.

(3) Glued-laminated columns shall conform to Section 4.3.

9.17.4.3. Columns in Contact With Concrete

(1) Wood columns shall be separated from concrete in contact with the ground by 0.05 mm polyethylene film or Type S roll roofing.

9.17.4.4. Wood Column Termite Protection

(1) Where termites are known to exist, exterior wood columns, such as porch supports, shall be,
(a) pressure-treated with a chemical that is toxic to such termites, in accordance with Article 9.3.2.9., or
(b) supported on non-cellulosic material extending not less than 150 mm above the finished ground and shall be located not less than 50 mm from the exterior wall of an adjacent *building*.

9.17.5. Unit Masonry Columns

9.17.5.1. Materials

(1) Unit masonry columns shall be built of masonry units,
(a) conforming to CAN/CSA-A165.1, “Concrete Block Masonry Units”, and
(b) having a compressive strength over the net area of the block of not less than 15 MPa.

9.17.5.2. Sizes

(1) Unit masonry columns shall be not less than 290 mm by 290 mm or 240 mm by 380 mm in size.

9.17.6. Solid Concrete Columns

9.17.6.1. Materials

(1) Concrete shall conform to Section 9.3.

9.17.6.2. Sizes

(1) Concrete columns shall be not less than 200 mm by 200 mm for rectangular columns and 230 mm diam for circular columns.

Section 9.18. Crawl Spaces

9.18.1. General

9.18.1.1. Application

(1) In this Section, a crawl space refers to an enclosed space between the underside of a floor assembly and the ground cover directly below, with a clearance less than 1 800 mm in height.

9.18.1.2. Foundations

(1) *Foundation* walls enclosing crawl spaces shall conform to Section 9.15.

9.18.1.3. Heated and Unheated Crawl Spaces

(1) Crawl spaces shall be considered to be heated where the space,
(a) is used as a warm air *plenum*,
(b) contains heating ducts or heating pipes that are not sealed and insulated to minimize heat loss to the space, or
(c) is not separated from heated space in accordance with Section 9.25.

(2) Heating of heated crawl spaces shall conform to Section 9.33.

(3) Insulation, an *air barrier system* and a *vapour barrier* shall be installed in the walls of heated crawl spaces in accordance with Section 9.25.

9.18.2. Access

9.18.2.1. Access Openings

(1) An access opening of not less than 500 mm by 700 mm shall be provided to each crawl space where the crawl space serves a single *dwelling unit*, and not less than 550 mm by 900 mm for other crawl spaces.

(2) Access openings shall be fitted with a door or hatch, except when the crawl space is heated and the access opening into the crawl space is from the adjacent heated space.

9.18.3. Ventilation

9.18.3.1. Ventilation of Unheated Crawl Spaces

(1) Unheated crawl spaces shall be ventilated by natural or mechanical means.

(2) Where an unheated crawl space is ventilated by natural means, ventilation shall be provided to the outside air by not less than 0.1 m^2 of unobstructed vent area for every 50 m^2 of *floor area*.

(3) Vents shall be,
(a) uniformly distributed on opposite sides of the *building*, and
(b) designed to prevent the entry of snow, rain and insects.

9.18.3.2. Ventilation of Heated Crawl Spaces

(1) Heated crawl spaces shall be ventilated in accordance with Section 9.32.

9.18.4. Clearance

9.18.4.1. Access Way to Services

(1) Where equipment requiring service such as plumbing cleanouts, traps and burners is located in crawl spaces, an access way with a height and width of not less than 600 mm shall be provided from the access door to the equipment and for a distance of 900 mm on the side or sides of the equipment to be serviced.

9.18.5. Drainage

9.18.5.1. Drainage

(1) Except where it can be shown to be unnecessary, the ingress of water into a crawl space shall be controlled by grading or drainage.

(2) Drainage of *foundation* walls shall conform to Article 9.14.2.1.

(3) Drainage of the ground cover or floor-on-ground in the crawl space shall conform to Subsection 9.16.3.

(4) Drains shall conform to Section 9.14.

9.18.6. Ground Cover

9.18.6.1. Ground Cover in Unheated Crawl Spaces

(1) Where a crawl space is unheated, a ground cover shall be provided consisting of not less than,
(a) 50 mm of asphalt paving material,
(b) 100 mm of 15 MPa Portland cement concrete,
(c) Type S roll roofing, or
(d) 0.10 mm polyethylene.

(2) Joints in sheet-type ground cover required in Sentence (1) shall be lapped not less than 100 mm and weighted down.

9.18.6.2. Ground Cover in Heated Crawl Spaces

(1) Where a crawl space is heated, a ground cover consisting of not less than 0.15 mm polyethylene sheet conforming to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet, for Use in Building Construction", shall be installed as part of an *air barrier system* in accordance with Subsection 9.25.3.

(2) The ground cover required in Sentence (1) shall,
(a) have its joints lapped not less than 300 mm, and sealed and weighted down, or
(b) be covered with a concrete skim coat not less than 50 mm thick.

(3) The perimeter of the ground cover required in Sentence (1) shall be sealed to the *foundation* wall.

9.18.7. Fire Protection

9.18.7.1. Crawl Spaces as Warm Air Plenums

(1) Only crawl spaces under 1-*storey* portions of *dwelling units* shall be used as warm air *plenums*.

(2) Enclosing material in crawl spaces described in Sentence (1), including insulation, shall have a surface *flame-spread rating* not greater than 150.

(3) *Combustible* ground cover used as enclosing material in Sentence (2) shall be covered with *noncombustible* material. (See Appendix A.)

(4) *Noncombustible* material described in Sentence (3) shall,
(a) extend not less than 300 mm beyond the projection of a register opening, and
(b) have turned-up edges.

Section 9.19. Roof Spaces

9.19.1. Venting

9.19.1.1. Required Venting

(1) Except where it can be shown to be unnecessary, where insulation is installed between a ceiling and the underside of the roof sheathing, a space shall be provided between the insulation and the sheathing, and vents shall be installed to permit the movement of air from the space to the exterior. (See Appendix A.)

9.19.1.2. Vent Requirements

(1) Except as provided in Sentence (2), the unobstructed vent area shall be not less than 1/300 of the insulated ceiling area.

(2) Where the roof slope is less than 1 in 6 or in roofs that are constructed with roof joists, the unobstructed vent area shall be not less than 1/150 of the insulated ceiling area.

(3) Required vents are permitted to be roof type, eave type, gable-end type or any combination of them, and shall be distributed,
(a) uniformly on opposite sides of the *building*,
(b) with not less than 25% of the required openings located at the top of the space, and
(c) with not less than 25% of the required openings located at the bottom of the space.

(4) Except where each roof joist space referred to in Sentence (2) is separately vented, roof joist spaces shall be interconnected by installing purlins not less than 38 mm by 38 mm on the top of the roof joists.

(5) Vents shall comply with CAN3-A93-M, "Natural Airflow Ventilators for Buildings".

9.19.1.3. Clearances

(1) Except as provided in Sentence (2), where venting is provided to a roof joist space, not less than 63 mm of space shall be provided between the top of the insulation and the underside of the roof sheathing.

(2) Where venting is provided at the junction of sloped roofs and exterior walls and where preformed baffles are used to contain the insulation, the baffles shall,
(a) provide an unobstructed air space between the insulation and the underside of the roof sheathing, that is,
  (i) not less than 25 mm in dimension, and
  (ii) of sufficient cross area to meet the *attic or roof space* venting requirements of Article 9.19.1.2., and
(b) extend vertically not less than 50 mm above the top of the insulation.

(3) Ceiling insulation shall be installed in a manner that will not restrict a free flow of air through roof vents or through any portion of the *attic or roof space*.

9.19.1.4. Mansard or Gambrel Roof

(1) The lower portion of a mansard or gambrel style roof need not be ventilated.

(2) The upper portion of roofs described in Sentence (1) shall be ventilated in conformance with the requirements in Articles 9.19.1.1. to 9.19.1.3.

9.19.2. Access

9.19.2.1. Access

(1) Every *attic or roof space* shall be provided with an access hatch where the *attic or roof space*,
(a) measures not less than,
  (i) 10 m^2 in area,
  (ii) 1 000 mm in length or width, and
  (iii) 600 mm in height over at least the area described in Subclauses (i) and (ii), or
(b) contains a fuel-fired *appliance*.

(2) Except where an *attic or roof space* contains a fuel-fired *appliance*, the hatch required in Sentence (1) shall be not less than 550 mm by 900 mm except that, where the hatch serves a single *dwelling unit*, the hatch may be reduced to,
(a) 0.32 m^2 in area with no dimension less than 545 mm, or
(b) 500 mm by 700 mm.
(See Appendix A.)

(3) Hatchways to *attic or roof spaces* shall be fitted with doors or covers.

Section 9.20. Masonry and Insulating Concrete Form Walls Not in Contact With the Ground

9.20.1. Application

9.20.1.1. General

(1) Except as provided in Article 9.20.1.2., this Section applies to,
(a) unreinforced masonry and masonry veneer walls not in contact with the ground, where,
  (i) the height of the walls constructed on the *foundation* walls does not exceed 11 m, and
  (ii) the roof or floor assembly above the *first storey* is not of concrete construction, and
(b) flat insulating concrete form walls not in contact with the ground that,
  (i) have a maximum floor to floor height of 3 m,
  (ii) are erected in *buildings* not more than 2 *storeys* in *building height* and containing only a single *dwelling unit*, and
  (iii) are erected in locations where the seismic spectral response acceleration, $S_a(0.2)$, is not greater than 0.4.
(See Appendix Note A-9.15.1.1(1)(c))

(2) For walls other than those described in Sentence (1), or where the masonry walls or insulating concrete form walls not in contact with the ground are designed for specified loads on the basis of ultimate and serviceability limit states, Subsection 4.3.2. shall apply.

9.20.1.2. Earthquake Reinforcement (See Appendix A.)

(1) In locations where the seismic spectral response acceleration, $S_a(0.2)$, is greater than 0.55, *loadbearing* elements of masonry *buildings* more than 1 *storey* in *building height* shall be reinforced with not less than the minimum amount of reinforcement as required in Subsection 9.20.15.

(2) In locations where the seismic spectral response acceleration, $S_a(0.2)$, is greater than 0.35, but less than or equal to 0.55, *loadbearing* elements of masonry *buildings* 3 *storeys* in *building height* shall be reinforced with not less than the minimum amount of reinforcement as required in Subsection 9.20.15.

9.20.2. Masonry Units

9.20.2.1. Masonry Unit Standards

(1) Masonry units shall comply with,
(a) ASTM C73, "Calcium Silicate Brick (Sand-Lime Brick)",
(b) ASTM C126, "Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units",
(c) ASTM C212, "Structural Clay Facing Tile",
(d) CAN/CSA-A82.1-M, "Burned Clay Brick (Solid Masonry Units Made from Clay or Shale)",
(e) CSA A82.4-M, "Structural Clay Load-Bearing Wall Tile",
(f) CSA A82.5-M, "Structural Clay Non-Load-Bearing Tile",
(g) CAN3-A82.8-M, "Hollow Clay Brick",
(h) CAN/CSA-A165.1, "Concrete Block Masonry Units",
(i) CAN/CSA-A165.2, "Concrete Brick Masonry Units",
(j) CAN/CSA-A165.3, "Prefaced Concrete Masonry Units", or
(k) CAN3-A165.4-M, "Autoclaved Cellular Units".

9.20.2.2. Used Brick

(1) Used bricks shall be free of old mortar, soot or other surface coating and shall conform to Article 9.20.2.1.

9.20.2.3. Glass Blocks

(1) Glass blocks shall not be used as *loadbearing* units or in the construction of fireplaces or *chimneys*.

9.20.2.4. Cellular Concrete

(1) Masonry made with cellular concrete shall not be used in contact with the *soil* or exposed to the weather.

9.20.2.5. Stone

(1) Stone shall be sound and durable.

9.20.2.6. Concrete Units Exposed to the Weather

(1) Concrete blocks exposed to the weather shall have weight and water absorption characteristics conforming to Classes A, B, C or D, described in CAN/CSA-A165.1, "Concrete Block Masonry Units".

9.20.2.7. Compressive Strength

(1) The compressive strength of concrete blocks shall conform to Table 9.20.2.7.

Table 9.20.2.7.
Compressive Strength of Concrete Blocks
Forming Part of Sentence 9.20.2.7.(1)

Type of Block	Minimum Compressive Strength Over Net Area, MPa	
	Exposed to Weather	Not Exposed to Weather
Solid or hollow concrete blocks	15	10
Solid loadbearing cellular blocks	Not permitted	5
Solid non-loadbearing cellular blocks	Not permitted	2
Column 1	2	3

9.20.3. Mortar

9.20.3.1. Mortar Materials

(1) Cementitious materials and aggregates for mortar and grout shall comply with CAN/CSA-A179, "Mortar and Grout for Unit Masonry".

(2) Water and aggregate shall be clean and free of significant amounts of deleterious materials.

(3) Lime used in mortar shall be hydrated.

(4) If lime putty is used in mortar, it shall be made by slaking quicklime in water for not less than 24 h or soaking hydrated lime in water for not less than 12 h.

9.20.3.2. Mortar and Grout Mixes

(1) Mortar types shall conform to Table 9.20.3.2.A.

(2) Mortar for glass block masonry shall be,
(a) Type S Portland cement-lime where exposed to the exterior, or
(b) Type S or N where protected from the exterior.

(3) Mortar mix proportions shall conform to Table 9.20.3.2.B., with sufficient water to bring the mixture to a consistency adequate for laying masonry units.

(4) Grout mix proportions shall conform to Table 9.20.3.2.C., with sufficient water to provide a suitable flow to fill all voids completely, without excessive segregation or bleeding.

(5) Except as provided in Sentence (6), mortar shall be used and placed in final position,
(a) within 1.5 h after mixing when the air temperature is 25°C or higher, and
(b) within 2.5 h after mixing when the air temperature is less than 25°C.

(6) Mortar and grout containing a set-control admixture shall be manufactured off-site in a batching plant and shall be used and placed in final position within a time not exceeding the useful life as stipulated by the manufacturer.

(7) Grout used for reinforced masonry shall be placed in accordance with the requirements of CAN/CSA-A371, "Masonry Construction for Buildings".

Table 9.20.3.2.A.
Mortar Use
Forming Part of Sentence 9.20.3.2.(1)

Location	Building Element	Mortar Type
Exterior, above ground	Loadbearing walls and columns	S
	Non-loadbearing walls and columns	N or S
	Parapets, chimneys and masonry veneer	N or S
Exterior, at or below ground	Foundation walls and chimneys	S
Interior	Loadbearing walls and columns	N
	Non-loadbearing walls and columns	N
Column 1	2	3

Table 9.20.3.2.B.
Mortar Mix Proportions (by Volume)
Forming Part of Sentence 9.20.3.2.(3)

Mortar Type	Portland Cement	Lime	Masonry Cement Type N	Masonry Cement Type S	Fine Aggregate (damp, loose-state sand)
S	1	½	—	—	3½ to 4½
	—	—	—	1	2¼ to 3
	½	—	1	—	3½ to 4½
N	1	1	—	—	4½ to 6
	—	—	1	—	2¼ to 3
Column 1	2	3	4	5	6

Table 9.20.3.2.C.
Grout Mix Proportions (by Volume)
Forming Part of Sentence 9.20.3.2.(4)

Portland Cement	Lime	Fine Aggregate (sand)	Coarse Aggregate
1	0 to 1/10	2¼ to 3 times the sum of the cement and lime volumes	1 to 2 times the sum of the cement and lime volumes
Column 1	2	3	4

9.20.4. Mortar Joints

9.20.4.1. Thickness

(1) Except as provided in Sentence (2), mortar joint thickness for burned clay brick and concrete masonry units shall be 10 mm.

(2) Permitted tolerances in head and bed joints shall be -5 mm to +10 mm.

9.20.4.2. Solid Masonry Units

(1) Except for head joints left open for weep holes and ventilation, solid masonry units shall be laid with full head and bed joints.

9.20.4.3. Hollow Masonry Units

(1) Hollow masonry units shall be laid with mortar applied to head and bed joints of both inner and outer face shells.

(2) Vertically aligned webs of hollow masonry units shall be laid in a full bed of mortar,
(a) under the starting course,
(b) in all courses of columns, and
(c) where adjacent to cells or cavities that are to be filled with grout.

9.20.5. Masonry Support

9.20.5.1. Masonry Support

(1) All masonry shall be supported on masonry, concrete or steel, except that masonry veneer walls are permitted to be supported on *foundations* of wood frame constructed in conformance with Sentence 9.15.2.4.(1). (See Appendix A.)

(2) Every masonry wall shall be at least as thick as the wall it supports, except as otherwise permitted in Article 9.20.12.2.

9.20.5.2. Lintels or Arches

(1) Masonry over openings shall be supported by steel, reinforced concrete lintels or masonry arches designed to support the imposed loads.

(2) Except as provided in Sentences (3) and (6), steel angle lintels supporting masonry above openings shall conform to Table 9.20.5.2.A.

(3) Steel angle lintels supporting masonry veneer above openings shall conform to Table 9.20.5.2.B.

(4) Steel lintels described in Sentences (2) and (3) shall,
(a) have even and level bearing and shall have not less than 150 mm length of bearing at end supports, and
(b) bear on masonry, concrete or steel.

(5) Steel angle lintels supporting masonry shall be primed or painted or otherwise protected from corrosion.

(6) Steel beams supporting masonry veneer and wood stud walls above openings shall conform to Table 9.20.5.2.C.

(7) Steel beams described in Sentence (6) shall be supported at each end by a steel column, and have a minimum 6 mm plate welded to the flange to support the masonry veneer.

Table 9.20.5.2.A.
Loose Steel Lintels for Masonry – No. & Size of Angles Required[6][7]
Forming Part of Sentence 9.20.5.2.(2)

Clear Span[1][3]	Exterior Angles, mm		Wall Thickness, mm	Interior Angles, mm						
	For Brick	For Stone		Maximum Floor Loads per Metre of Span in Newtons[2][4][5]						
	100 mm	100 mm + 50 mm stone facing		None	3 650	7 300	10 950	14 600	18 250	21 900
	No Floor Load									
1.2 m or less	L-89 × 89 × 6.4	L-127 × 89 × 7.9	203	L-89 × 89 × 6.4	L-89 × 89 × 6.4	L-89 × 89 × 7.9	L-102 × 89 × 7.9	L-127 × 89 × 7.9	L-127 × 89 × 11	L-127 × 89 × 13
			305	2Ls-89 × 89 × 7.9	2Ls-89 × 89 × 7.9	2Ls-89 × 89 × 7.9	2Ls-89 × 89 × 7.9	2Ls-89 × 89 × 7.9	2Ls-102 × 89 × 7.9	2Ls-102 × 89 × 7.9
1.5 m	L-89 × 89 × 7.9	L-127 × 89 × 7.9	203	L-89 × 89 × 7.9	L-89 × 89 × 7.9	L-127 × 89 × 7.9	L-127 × 89 × 11	L-127 × 89 × 13	L-152 × 89 × 11	
			305	2Ls-89 × 89 × 7.9	2Ls-89 × 89 × 7.9	2Ls-89 × 89 × 7.9	2Ls-127 × 89 × 7.9	2Ls-127 × 89 × 7.9	2Ls-127 × 89 × 7.9	2Ls-127 × 89 × 11
1.8 m	L-102 × 89 × 7.9	L-127 × 127 × 7.9	203	L-102 × 89 × 7.9	L-127 × 89 × 7.9	L-127 × 89 × 7.9	L-152 × 102 × 11			
			305	2Ls-102 × 89 × 7.9	2Ls-102 × 89 × 7.9	2Ls-127 × 89 × 7.9	2Ls-127 × 89 × 7.9	2Ls-127 × 89 × 11	2Ls-152 × 102 × 11	2Ls-152 × 102 × 11
2.1 m	L-102 × 89 × 7.9	L-127 × 127 × 7.9	203	L-102 × 89 × 7.9	L-127 × 89 × 11	L-152 × 102 × 11				
			305	2Ls-102 × 89 × 7.9	2Ls-127 × 89 × 11	2Ls-127 × 89 × 11	2Ls-152 × 102 × 11	2Ls-152 × 102 × 11		
2.4 m	L-127 × 89 × 7.9	L-127 × 127 × 7.9	203	L-127 × 89 × 7.9	L-152 × 102 × 11					
			305	2Ls-127 × 89 × 7.9	2Ls-127 × 89 × 13	2Ls-152 × 102 × 11				
2.7 m	L-127 × 89 × 11	L-127 × 127 × 11	203	L-127 × 89 × 11						
			305	2Ls-127 × 152 × 11	2Ls-152 × 102 × 11					
3.0 m	L-152 × 102 × 11	L-127 × 127 × 13	203	L-152 × 102 × 11						
			305	2Ls-152 × 102 × 11						
Column 1	2	3	4	5	6	7	8	9	10	11

Notes to Table 9.20.5.2.A.:

(1) See Sentence 9.20.5.2.(4).
(2) Omit floor load in lintel when distance to bottom of floor construction is greater than width of opening.
(3) Interior and exterior angles in 200 mm walls and interior angles in 300 mm walls are bolted together when clear span is over 1 800 mm.
(4) When masonry lighter than brick is used over interior angles floor load may be increased by the difference in weight per square metre times the width of the opening. Not generally available.
(5) Interior angles have been designed for floor load plus brick masonry of height equal to width of opening.
(6) fs = 138 MPa., Deflection maximum = 1/700 span.
(7) The figures in the Table indicating wall thickness and angle cross-section are in mm.

Table 9.20.5.2.B.
Maximum Allowable Spans for Steel Lintels Supporting Masonry Veneer, m
Forming Part of Sentence 9.20.5.2.(3)

Minimum Angle Size, mm			Maximum Allowable Spans, m		
Vertical Leg	Horizontal Leg	Thickness	70 mm Brick	90 mm Brick	100 mm Stone
89	76	6.4	2.55	—	—
89	89	6.4	2.59	2.47	2.30
102	89	6.4	2.79	2.66	2.48
127	89	7.9	3.47	3.31	3.08
127	89	11	3.64	3.48	3.24
127	89	13	3.82	3.59	3.33
152	89	11	4.06	3.82	3.54
152	89	13	4.32	4.07	3.77
152	102	13	4.37	4.12	3.82
178	102	11	4.57	4.30	3.99
178	102	13	4.87	4.59	4.25
Column 1	2	3	4	5	6

Table 9.20.5.2.C.
Maximum Allowable Spans for Steel Beams Supporting Masonry Veneer, m(1)(2)(3)
Forming Part of Sentence 9.20.5.2.(6)

Section	70 mm Brick	90 mm Brick	100 mm Stone
W150 × 22	4.23	4.09	3.92
W150 × 30	4.68	4.52	4.32
W200 × 27	5.26	5.08	4.84
W200 × 31	5.57	5.37	5.11
W200 × 36	5.70	5.49	5.23
Column 1	2	3	4

Notes to Table 9.20.5.2.C.:

(1) These spans assume that the beam supports the veneer, a wood stud wall and a maximum specified roof live load of 2.3 kN/m.
(2) Where the steel beam carries floor loads or larger roof loads, refer to Article 9.23.4.3.
(3) See Appendix A.

9.20.6. Thickness and Height

9.20.6.1. Thickness of Exterior Walls

(1) Masonry exterior walls, other than *cavity walls*, in 1 *storey buildings* and the top *storeys* of 2 and 3 *storey buildings* shall be not less than 140 mm thick provided the walls are not more than 2.8 m high at the eaves and 4.6 m high at the peaks of gable ends.

(2) The exterior walls of the bottom *storeys* of 2 *storey buildings*, and exterior walls of the bottom 2 *storeys* of 3 *storey buildings* shall be not less than 190 mm thick.

(3) In exterior walls composed of more than one wythe, each wythe shall be not less than 90 mm thick.

9.20.6.2. Cavity Walls

(1) *Cavity walls* shall be made with not less than 90 mm wide units if the joints are raked and not less than 75 mm wide units if the joints are not raked.

(2) The width of a cavity in a *cavity wall* shall be not less than 50 mm and not greater than 150 mm.

(3) The minimum thickness of *cavity walls* above the supporting base shall be 230 mm for the top 7.6 m and 330 mm for the remaining portion, except that where 75 mm wide units are used, the wall height above the top of the *foundation* wall shall not exceed 6 m.

9.20.6.3. Thickness of Interior Walls

(1) The thickness of *loadbearing* interior walls shall be determined on the basis of the maximum lateral support spacing as provided in Sentences 9.20.10.1.(2) and (3).

(2) The thickness of interior non-*loadbearing* walls shall be,
(a) determined on the basis of the maximum lateral support spacing as provided in Sentences 9.20.10.1.(2) and (3), and
(b) in any case, not less than 65 mm.

9.20.6.4. Masonry Veneer

(1) Except for masonry veneer where each masonry unit is supported individually by the structural backing, masonry veneer shall be of solid units not less than 70 mm thick.

(2) Veneer described in Sentence (1) over wood frame walls shall have not less than a 25 mm air space behind the veneer.

(3) Masonry veneer less than 90 mm thick shall have unraked joints.

(4) Masonry veneer shall conform to Subsection 4.3.2. where the masonry units are required to be individually supported by the structural backing.

9.20.6.5. Parapet Walls

(1) The height of parapet walls above the adjacent roof surface shall be not more than three times the parapet wall thickness.

(2) Parapet walls shall be solid from the top of the parapet to not less than 300 mm below the adjacent roof level.

9.20.6.6. Stone or Concrete Facings

(1) Slab and panel facings of precast concrete and natural or artificial stone shall conform to Subsection 4.3.2.

9.20.7. Chases and Recesses

9.20.7.1. Maximum Dimensions

(1) Except as provided in Sentence 9.20.7.2.(2) and Article 9.20.7.4., the depth of any chase or recess shall not exceed one-third the thickness of the wall, and the width of the chase or recess shall not exceed 500 mm.

9.20.7.2. Minimum Wall Thickness

(1) Except as provided in Sentence (2) and Article 9.20.7.4., no chase or recess shall be constructed in any wall 190 mm or less in thickness.

(2) Recesses may be constructed in 190 mm walls provided they do not exceed 100 mm in depth, 750 mm in height and 500 mm in width.

9.20.7.3. Separation of Chases and Recesses

(1) Chases and recesses shall be not less than,
(a) four times the wall thickness apart, and
(b) 600 mm away from any pilaster, cross wall, buttress or other vertical element providing required lateral support for the wall.

9.20.7.4. Non-Conforming Chases or Recesses

(1) Chases or recesses that do not conform to the limits specified in Articles 9.20.7.1. to 9.20.7.3. shall be considered as openings, and any masonry supported above such a chase or recess shall be supported by a lintel or arch as provided in Article 9.20.5.2.

9.20.7.5. Chases or Recesses Cut into Walls

(1) Chases or recesses shall not be cut into walls made with hollow units after the masonry units are in place.

9.20.8. Support of Loads

9.20.8.1. Capping of Hollow Masonry Walls

(1) Except as permitted in Sentence (2), *loadbearing* walls of hollow masonry units supporting roof or floor framing members shall be capped with not less than 50 mm of solid masonry or have the top course filled with concrete.

(2) Capping required in Sentence (1) may be omitted where the roof framing is supported on a wood plate not less than 38 mm by 89 mm.

9.20.8.2. Cavity Walls Supporting Framing Members

(1) Floor joists supported on *cavity walls* shall be supported on solid units not less than 57 mm high.

(2) Floor joists described in Sentence (1) shall not project into the cavity.

(3) Roof and ceiling framing members bearing on *cavity walls* shall be supported on,
(a) not less than 57 mm of solid masonry, bridging the full thickness of the wall, or
(b) a wood plate not less than 38 mm thick, bearing not less than 50 mm on each wythe.

9.20.8.3. Bearing of Beams and Joists

(1) The bearing area under beams and joists shall be sufficient to carry the supported load.

(2) In no case shall the minimum length of end bearing of beams supported on masonry be less than 90 mm.

(3) The length of end bearing of floor, roof or ceiling joists supported on masonry shall be not less than 40 mm.

9.20.8.4. Support of Beams and Columns

(1) Beams and columns supported on masonry walls shall be supported on pilasters where the thickness of the masonry wall or wythe is less than 190 mm.

(2) Not less than 190 mm depth of solid masonry or concrete shall be provided under the beam or column referred to in Sentence (1).

(3) Pilasters required in Sentence (1) shall be bonded or tied to masonry walls.

(4) Concrete pilasters required in Sentence (1) shall be not less than 50 mm by 300 mm.

(5) Unit masonry pilasters required in Sentence (1) shall be not less than 100 mm by 290 mm.

9.20.8.5. Distance to Edge of Supporting Members (See Appendix A.)

(1) Masonry veneer of hollow units resting on bearing support shall not project more than,
(a) 30 mm beyond the supporting base where the veneer is not less than 90 mm thick, and
(b) 12 mm beyond the supporting base where the veneer is less than 90 mm thick.

(2) Masonry veneer of solid units resting on bearing support shall not project more than one-third of the width of the veneer.

(3) Where the masonry veneer described in Sentence (2) is rough stone masonry,
(a) the projection shall be measured as the average projection of the units, and
(b) the width of the veneer shall be measured as the average width of the veneer.

9.20.9. Bonding and Tying

9.20.9.1. Joints to be Offset or Reinforced

(1) Vertical joints in adjacent masonry courses shall be offset unless each wythe of masonry is reinforced with the equivalent of no fewer than two corrosion-resistant steel bars of 3.76 mm diam placed in the horizontal joints at vertical intervals not exceeding 460 mm.

(2) Where joints in the reinforcing referred to in Sentence (1) occur, the bars shall be lapped not less than 150 mm.

9.20.9.2. Bonding or Tying of Other Than Masonry Veneer

(1) Except as provided in Article 9.20.9.5 for masonry veneer, masonry walls that consist of two or more wythes shall have the wythes bonded or tied together with masonry bonding units as described in Article 9.20.9.3. or with metal ties as described in Articles 9.20.9.4.

9.20.9.3. Bonding

(1) Where wythes are bonded together with masonry units, the bonding units shall comprise not less than 4 percent of the wall surface area.

(2) Bonding units described in Sentence (1) shall be spaced not more than 600 mm vertically and horizontally in the case of brick masonry and 900 mm o.c. in the case of block or tile.

(3) Units described in Sentence (1) shall extend not less than 90 mm into adjacent wythes.

9.20.9.4. Tying

(1) Where two or more wythes are tied together with metal ties of the individual rod type, the ties shall conform to the requirements in Sentences (3) to (6).

(2) Other ties may be used where it can be shown that such ties provide walls that are at least as strong and as durable as those made with the individual rod type.

(3) Metal ties of the individual rod type shall,
(a) be corrosion-resistant,
(b) have a minimum cross-sectional area of not less than 17.8 mm^2, and
(c) have not less than a 50 mm portion bent at right angles at each end.

(4) Metal ties of the individual rod type shall,
(a) extend from within 25 mm of the outer face of the wall to within 25 mm of the inner face of the wall,
(b) be completely embedded in mortar except for the portion exposed in *cavity walls*, and
(c) be staggered from course to course.

(5) Where two or more wythes in walls other than *cavity walls* and masonry veneer/masonry back-up walls are tied together with metal ties of the individual rod type, the space between wythes shall be completely filled with mortar.

(6) Ties described in Sentence (5) shall be,
(a) located within 300 mm of openings and spaced not more than 900 mm apart around openings, and
(b) spaced not more than 900 mm apart horizontally and 460 mm apart vertically at other locations.

(7) Except as required in Sentences (8) and (9), where the inner and outer wythes of *cavity walls* are tied with individual wire ties, the ties shall be spaced not more than 900 mm apart horizontally and 400 mm apart vertically.

(8) Within 100 mm of the bottom of each floor or roof assembly where the cavity extends below the assemblies, the ties described in Sentence (7) shall be spaced not more than 600 mm apart horizontally.

(9) Within 300 mm of any openings, the ties described in Sentence (7) shall be spaced not more than 900 mm apart.

9.20.9.5. Ties for Masonry Veneer

(1) Masonry veneer 70 mm or more in thickness and resting on a bearing support shall be tied to masonry back-up or to wood framing members with straps that are,
(a) corrosion-resistant,
(b) not less than 0.76 mm thick,
(c) not less than 22 mm wide,
(d) shaped to provide a key with the mortar, and
(e) spaced in accordance with Table 9.20.9.5.

Table 9.20.9.5.
Veneer Tie Spacing
Forming Part of Sentence 9.20.9.5.(1)

Maximum Vertical Spacing, mm	Maximum Horizontal Spacing, mm
400	800
500	600
600	400
Column 1	2

(2) The straps described in Sentence (1) that are fastened to the wood framing members shall be,
(a) bent at a right angle within 6 mm from the fastener, and
(b) fastened with corrosion resistant 3.18 mm diam screws or spiral nails having a wood penetration of not less than 30 mm.

(3) Masonry veneer individually supported by masonry or wood frame back-up shall be secured to the back-up in conformance with Subsection 4.3.2.

(4) The straps described in Sentence (1) may be installed against one of the sheathings listed in Table 9.23.16.2.A. provided that,
(a) the tie is in contact with the exterior surface of the sheathing, and
(b) the sheathing beneath the tie is not compressed.

9.20.9.6. Reinforcing for Glass Block

(1) Glass block shall have horizontal joint reinforcement of two corrosion-resistant bars of not less than 3.76 mm diam or expanded metal strips not less than 75 mm wide,
(a) spaced at vertical intervals of not more than 600 mm for units 190 mm or less in height, and
(b) installed in every horizontal joint for units higher than 190 mm.

(2) Reinforcement required in Sentence (1) shall be lapped not less than 150 mm.

9.20.10. Lateral Support

9.20.10.1. Lateral Support Required

(1) Masonry walls shall be laterally supported by floor or roof construction or by intersecting masonry walls or buttresses.

(2) The spacing of supports required in Sentence (1) shall be not more than,
(a) 20 times the wall thickness for all *loadbearing* walls and exterior non-*loadbearing* walls, and
(b) 36 times the wall thickness for interior non-*loadbearing* walls.

(3) In applying Sentence (2), the thickness of *cavity walls* shall be taken as the greater of,
(a) two-thirds of the sum of the thicknesses of the wythes, or
(b) the thickness of the thicker wythe.

(4) Floor and roof structural elements providing lateral support for walls as required in Sentence (1) shall be constructed to transfer lateral loads to walls or buttresses approximately at right angles to the laterally supported walls.

9.20.11. Anchorage of Roofs, Floors and Intersecting Walls

9.20.11.1. Anchorage of Floor or Roof Assemblies

(1) Where required to receive lateral support, masonry walls shall be anchored to each floor or roof assembly at maximum intervals of 2 m, except that anchorage of floor joists not more than 1 m above grade may be omitted.

(2) Anchors required in Sentence (1) shall be corrosion-resistant and be not less than the equivalent of 40 mm by 4.76 mm thick steel straps.

(3) Anchors required in Sentence (1) shall be shaped to provide a mechanical key with the masonry and shall be securely fastened to the horizontal support to develop the full strength of the anchor.

(4) When joists are parallel to the wall, anchors required in Sentence (1) shall extend across no fewer than three joists.

9.20.11.2. Bonding and Tying of Intersecting Walls

(1) Where required to provide lateral support, intersecting walls shall be bonded or tied together.

(2) Where bonding is used to satisfy the requirements of Sentence (1), 50% of the adjacent masonry units in the intersecting wall, distributed uniformly over the height of the intersection, shall be embedded in the laterally supported wall.

(3) Where tying is used to satisfy the requirements of Sentence (1), the ties shall be,
(a) corrosion-resistant metal,
(b) equivalent to not less than 4.76 mm by 40 mm steel strapping,
(c) spaced not more than 800 mm o.c. vertically, and
(d) shaped at both ends to provide sufficient mechanical key to develop the strength of the ties.

9.20.11.3. Wood Frame Walls Intersecting Masonry Walls

(1) Wood frame walls shall be tied to intersecting masonry walls with not less than 4.76 mm diam corrosion-resistant steel rods spaced not more than 900 mm o.c. vertically.

(2) Ties required in Sentence (1) shall be anchored to the wood framing at one end and shaped to provide a mechanical key at the other end to develop the strength of the tie.

9.20.11.4. Wood Frame Roof Systems

(1) Except as permitted in Sentence (2), roof systems of wood frame construction shall be tied to exterior masonry walls by not less than 12.7 mm diam anchor bolts,
(a) spaced not more than 2.4 m apart,
(b) embedded not less that 90 mm into the masonry, and
(c) fastened to a rafter plate of not less than 38 mm thick lumber.

(2) The roof system described in Sentence (1) is permitted to be anchored by nailing the wall furring strips to the side of the rafter plate.

9.20.11.5. Cornices, Sills and Trim

(1) Cornices, sills or other trim of masonry material that project beyond the wall face shall have not less than 65% of their mass, but not less than 90 mm, within the wall or shall be adequately anchored to the wall with corrosion-resistant anchors.

9.20.11.6. Piers

(1) Where anchor bolts are to be placed in the top of a masonry pier, the pier shall conform to the requirements of Sentence 9.15.2.3.(4) and shall be capped with concrete or reinforced masonry not less than 200 mm thick.

9.20.12. Corbelling

9.20.12.1. Corbelling

(1) All corbelling shall consist of solid units.

(2) The units referred to in Sentence (1) shall be corbelled so that the horizontal projection of any unit does not exceed 25 mm and the total projection does not exceed one-third of the total wall thickness.

9.20.12.2. Corbelling for Cavity Walls

(1) *Cavity walls* of greater thickness than the *foundation* wall on which they rest shall not be corbelled but may project 25 mm over the outer face of the *foundation* wall disregarding parging.

(2) Where the *foundation* wall referred to in Sentence (1) is unit masonry, it is permitted to be corbelled to meet flush with the inner face of a *cavity wall* provided,
(a) the projection of each course does not exceed half the height or one-third the width of the corbelled unit, and
(b) the total corbel does not exceed one-third of the *foundation* wall thickness.
(See Appendix A.)

9.20.12.3. Corbelling for Masonry Veneer

(1) Masonry veneer resting on a bearing support shall not project more than 25 mm beyond the supporting base where the veneer is at least 90 mm thick, and 12 mm beyond the supporting base where the veneer is less than 90 mm thick.

(2) In the case of rough stone veneer, the projection, measured as the average projection of the stone units, shall not exceed one-third the bed width beyond the supporting base.

9.20.13. Control of Rain Water Penetration

9.20.13.1. Materials for Flashing

(1) Materials used for flashing shall conform to Table 9.20.13.1.

(2) Aluminum flashing in contact with masonry or concrete shall be effectively coated or separated from the masonry or concrete by an impervious membrane.

Table 9.20.13.1.
Flashing Materials
Forming Part of Sentence 9.20.13.1.(1)

Material	Minimum Thickness, mm	
	Exposed Flashing	Concealed Flashing
Aluminum	0.48	—
Copper	0.46	0.46
Copper or aluminum laminated to felt or kraft paper	—	0.05
Hot dipped or galvanized steel	0. 33	0.33
Lead sheet	1.73	1.73
Polyethylene	—	0.50
Roll roofing, Type S	—	standard
Zinc	0.46	0.46
Column 1	2	3

9.20.13.2. Fastening of Flashing

(1) Fastening devices for flashing shall be corrosion-resistant and, where metal flashing is used, shall be compatible with the flashing with respect to galvanic action.

9.20.13.3. Location of Flashing

(1) Flashing shall be installed in masonry and masonry veneer walls,
(a) beneath jointed masonry window sills,
(b) over the back and top of parapet walls,
(c) over the heads of glass block panels,
(d) beneath weep holes, and
(e) over the heads of window and door openings in exterior walls when the vertical distance between the top of a window or door frame and the bottom edge of the eave exceeds one-quarter of the horizontal eave overhang.

(2) Throughwall flashing shall be provided in a masonry veneer wall such that any moisture that accumulates in the air space will be directed to the exterior of the *building*.

9.20.13.4. Extension of Flashing

(1) When installed beneath jointed masonry window sills and jointed masonry copings or over the heads of openings, flashing shall extend from the front edge of the masonry up behind the sill or lintel.

(2) A flashing may be omitted when the masonry at the sill of a wall opening or the top of a wall is protected by an impervious non-jointed masonry coping that conforms to Article 9.20.13.12.

9.20.13.5. Flashing for Weep Holes in Masonry Veneer/Masonry Walls

(1) Flashing beneath weep holes in *cavity walls* and masonry veneer/masonry back-up walls shall,
(a) be bedded not less than 25 mm in the inside wythe,
(b) extend to not less than 5 mm beyond the outer face of the *building* element below the flashing, and
(c) be installed with a nominally horizontal slope toward the outside wythe.

9.20.13.6. Flashing for Weep Holes in Masonry Veneer

(1) Flashing beneath weep holes in masonry veneer over masonry back-up walls shall conform to the flashing requirements for *cavity walls* and masonry veneer/masonry back-up walls in Article 9.20.13.5.

(2) Flashing beneath weep holes in masonry veneer over wood frame walls shall be installed so that it extends from a point not less than 5 mm beyond the outer face of the *building* element below the flashing to a point 150 mm up the wood frame wall.

(3) Where the frame wall is sheathed with a sheathing membrane, a non-wood-based rigid exterior insulating sheathing or a semi-rigid insulating sheathing with an integral sheathing membrane, the flashing shall be installed behind the sheathing membrane or insulating sheathing.

(4) Flashing described in Sentence (2) is permitted to conform to the requirements for concealed flashing in Table 9.20.13.1.

9.20.13.7. Flashing Joints

(1) Joints in flashing shall be made watertight.

9.20.13.8. Required Weep Holes

(1) Weep holes spaced not more than 800 mm apart shall be provided at the bottom of,
(a) cavities in *cavity walls*, and
(b) cavities or air spaces in masonry veneer walls.

(2) The cavities or air spaces described in Sentence (1) shall include those above lintels over window and door openings required to be flashed in conformance with Article 9.20.13.3.

(3) The weep holes required in Sentence (1) shall be in a location such that any water that collects in the cavity or space will be directed to the exterior of the *building*.

9.20.13.9. Protection of Interior Finish

(1) Except as provided in Sentence (3), where the interior finish of the exterior walls of a *building* is a type that may be damaged by moisture, exterior masonry walls, other than *cavity walls* or walls that are protected for their full height by a roof of a carport or porch, shall be,
(a) parged on the interior surface, and
(b) covered with No. 15 breather-type asphalt-saturated paper conforming to CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type", and shall be lapped not less than 100 mm at the joints.

(2) In situations described in Sentence (1), flashing shall be provided where water will accumulate, to lead it to the exterior.

(3) Where the insulation effectively limits the passage of water vapour and is applied by a waterproof adhesive or by mortar directly to the masonry, the requirements for sheathing paper do not apply. (See Appendix A.)

9.20.13.10. Mortar Droppings

(1) *Cavity walls* shall be constructed so that mortar droppings are prevented from forming a bridge to allow the passage of rain water across the cavity.

9.20.13.11. Caulking at Door and Window Frames

(1) The junction of door and window frames with masonry shall be caulked in conformance with Subsection 9.27.4.

9.20.13.12. Drips Beneath Window Sills

(1) Except for wall openings located less than 150 mm above ground level, where a concealed flashing is not installed beneath window and door sills, such sills shall be provided with an outward slope and a drip located not less than 25 mm from the wall surface.

9.20.14. Protection During Work

9.20.14.1. Laying Temperature of Mortar and Masonry

(1) Mortar and masonry shall be maintained at a temperature not below 5°C during installation and for not less than 48 h after installation.

(2) No frozen material shall be used in the mortar mix.

9.20.14.2. Protection from Weather

(1) The top surface of uncompleted masonry exposed to the weather shall be completely covered with a waterproofing material when construction is not in progress.

9.20.15. Reinforcement for Earthquake Resistance

9.20.15.1. Amount of Reinforcement

(1) Where reinforcement is required in this Section, masonry walls shall be reinforced horizontally and vertically with steel having a total cross-sectional area of not less than 0.002 times the horizontal cross-sectional area of the wall, so that not less than one-third of the required steel area is installed either horizontally or vertically and the remainder in the other direction.

9.20.15.2. Installation Standard

(1) Where reinforcement for masonry is required in this Section, it shall be installed in conformance with the requirements for reinforced masonry as contained in CAN/CSA-A371, "Masonry Construction for Buildings".

9.20.16. Corrosion Resistance

9.20.16.1. Corrosion Resistance of Connectors

(1) Carbon steel connectors required to be corrosion-resistant shall be galvanized to at least the minimum standards in Table 9.20.16.1.

Table 9.20.16.1.
Minimum Requirements for Galvanizing
Forming Part of Sentence 9.20.16.1.(1)

Connector Material	ASTM Standard	Coating Class
Wire ties and continuous reinforcing (hot-dipped galvanizing)	A153 / A153M	Class B2 or 458 g/m²
Hardware and bolts	A153 / A153M	See A153 / A153M
Strip, plate, bars, and rolled sections (not less than 3.18 mm thick)	A123 / A123M	610 g/m²
Sheet (less than 3.18 mm thick)	A123 / A123M	305 g/m² on material 0.76 mm thick(1)
Column 1	2	3

Notes to Table 9.20.16.1.:

(1) ASTM A123 / A123M does not apply to metal less than 3.18 mm thick. Galvanizing coatings may be interpolated for thicknesses between 3.18 mm and 0.76 mm.

9.20.17. Above-Ground Flat Insulating Concrete Form Walls

9.20.17.1. Thickness of Flat Insulating Concrete Form Walls

(1) The thickness of concrete in flat insulating concrete form walls not in contact with the ground shall be,
(a) not less than 140 mm, and
(b) constant for the entire height of the wall.

9.20.17.2. Reinforcement for Flat Insulating Concrete Form Walls

(1) Horizontal reinforcement in above-grade flat insulating concrete form walls shall,
(a) consist of,
(i) one 10M bar placed not more than 300 mm from the top of the wall, and
(ii) 10M bars spaced not more than 600 mm o.c., and
(b) be placed in the middle third of the wall section.

(2) Vertical reinforcement in above-grade flat insulating concrete form walls shall,
(a) consist of 10M bars spaced not more than 400 mm o.c., and
(b) be placed in the middle third of the wall section.

(3) Vertical reinforcement required in Sentence (2) and interrupted by wall openings shall be placed not more than 600 mm from each side of the opening.

9.20.17.3. Openings in Non-Loadbearing Flat Insulating Concrete Form Walls

(1) No openings shall occur within 1.2 m of interior and exterior corners of exterior non-*loadbearing* flat insulating concrete form walls.

(2) Portions of walls over openings in non-*loadbearing* flat insulating concrete form walls shall have a minimum depth of concrete of not less than 200 mm over the width of the opening.

(3) Openings more than 600 mm but not more than 3 m in width in non-*loadbearing* flat insulating concrete form walls shall be reinforced at the top and bottom with one 10M bar.

(4) Openings more than 3 m in width in non-*loadbearing* flat insulating concrete form walls shall be reinforced on all four sides with two 10M bars.

(5) Reinforcing bars described in Sentences (3) and (4) shall extend not less than 600 mm beyond the edges of the opening.

(6) The cumulative width of openings in non-*loadbearing* flat insulating concrete form walls shall be not more than 70% of the length of any wall.

9.20.17.4. Openings in Loadbearing Flat Insulating Concrete Form Walls

(1) No openings shall occur within 1.2 m of interior and exterior corners of exterior *loadbearing* flat insulating concrete form walls.

(2) In *loadbearing* flat insulating concrete form walls, lintels shall be provided over all openings wider than 900 mm.

(3) Lintels described in Sentence (2) shall be constructed in accordance with Table A-17, A-18 or A-19.

(4) Lintels described in Sentence (2) over openings wider than 1.2 m shall be reinforced for shear with 10M stirrups at a maximum spacing of half the distance from the bottom reinforcing bar to the top of the lintel.

9.20.17.5. Framing Supported on Flat Insulating Concrete Form Walls

(1) Floor joists supported on the side of flat insulating concrete form walls shall be supported with joist hangers secured to wood ledger boards.

(2) The ledger boards described in Sentence (1) shall be not less than,
(a) 38 mm thick, and
(b) the depth of the floor joists.

(3) Anchor bolts shall be used to secure ledger boards to flat insulating concrete form walls and shall be,
(a) embedded in the wall to a depth not less than 100 mm, and
(b) spaced in accordance with Table 9.20.17.5.

(4) Floor joists and *building* frames supported on top of flat insulating concrete form walls shall be anchored in conformance with Article 9.23.6.1.

Table 9.20.17.5.
Maximum Anchor Bolt Spacing for the Connection of Ledger Boards to Flat Insulating Concrete Form Walls
Forming Part of Sentence 9.20.17.5.(3)

Maximum Clear Floor Span, m	Maximum Anchor Bolt Spacing, mm	
	Staggered 12.7 mm Diameter Anchor Bolts	Staggered 16 mm Diameter Anchor Bolts
2.44	450	500
3.00	400	450
4.00	300	400
5.00	275	325
Column 1	2	3

9.20.17.6. Anchoring of Roof Framing to Top of Flat Insulating Concrete Form Walls

(1) Roof framing supported on the top of flat insulating concrete form walls shall be fixed to the top plates, which shall be anchored to the wall with anchor bolts,
(a) not less than 12.7 mm in diameter, and
(b) spaced not more than 1.2 m o.c.

(2) The anchor bolts described in Sentence (1) shall be placed in the centre of the flat insulating concrete form wall and shall be embedded not less than 100 mm into the concrete.

(3) Attachment of roof framing to wood top plates shall be in accordance with Table 9.23.3.4.

9.20.17.7. Protection from Precipitation and Damage

(1) Above ground flat insulating concrete form walls shall be protected from precipitation and damage in conformance with Section 9.27.

Section 9.21. Masonry and Concrete Chimneys and Flues

9.21.1. General

9.21.1.1. Application

(1) This Section applies to,
(a) rectangular *masonry or concrete chimneys* not more than 12 m in height serving fireplaces or serving *appliances* having a combined total rated heat output of 120 kW or less, and
(b) *flue pipes* serving solid fuel-burning *appliances*.

(2) Except as provided in Sentence 9.21.1.3.(1), *chimneys* (other than those described in Sentence (1) and Sentence 9.21.1.2.(1)), *gas vents* and *flue pipes* serving gas-, oil- or solid fuel-burning *appliances* and associated equipment shall conform to Section 6.3.

9.21.1.2. Factory-Built Chimneys

(1) *Factory-built chimneys* serving solid fuel-burning *appliances*, and their installation, shall conform to CAN/ULC-S629-M, "650°C Factory-Built Chimneys". (See Appendix A.)

9.21.1.3. Flue Pipes

(1) *Flue pipes* serving solid fuel-burning *stoves*, *cooktops* and *space heaters* shall conform to CAN/CSA-B365, "Installation Code for Solid-Fuel Burning Appliances and Equipment".

9.21.1.4. Chimney or Flue Pipe Walls

(1) The walls of any *chimney* or *flue pipe* shall be constructed to be smoke- and flame-tight.

9.21.2. Chimney Flues

9.21.2.1. Chimney Flue Limitations

(1) A *chimney flue* that serves a fireplace or incinerator shall not serve any other *appliance*.

(2) A *chimney flue* that serves a solid fuel-burning *appliance* shall not be connected to a natural gas- or propane-fired *appliance*.

(3) A *chimney flue* that serves a solid fuel-burning *appliance* shall not be connected to an oil-burning *appliance* unless the solid fuel-burning *appliance* is *listed* for such installation and the installation of both *appliances* meets their respective installation requirements.

9.21.2.2. Connections of More Than One Appliance

(1) Except as required in Article 9.21.2.1., two or more fuel-burning *appliances* are permitted to be connected to the same *chimney flue* provided adequate draft is maintained for the connected *appliances* and the connections are made as described in Sentences (2) and (3).

(2) Where two or more solid fuel-burning *appliances* are connected to the same *chimney flue*, the *appliances* must be located on the same *storey*.

(3) The connection referred to in Sentence (2) for a solid fuel-burning *appliance* shall be made below connections for *appliances* burning other fuels.

9.21.2.3. Inclined Chimney Flues

(1) *Chimney flues* shall not be inclined more than 45° to the vertical.

9.21.2.4. Size of Chimney Flues

(1) Except for *chimneys* serving fireplaces, the size of a *chimney flue* shall conform to the requirements of the solid fuel-burning *appliance* installation standard referenced in Sentence 6.2.1.4.(1) and Article 9.33.1.2.

(2) Where a *chimney flue* serves only one solid fuel-burning *appliance*, the *flue* area shall be at least equal to that of the *flue pipe* connected to it.

9.21.2.5. Fireplace Chimneys

(1) The size of a *chimney flue* serving a masonry fireplace shall be within the allowable range specified in Table 9.21.2.5.A. or Table 9.21.2.5.B.

Table 9.21.2.5.A.
Diameter of Round Flues for Fireplace Chimneys
Forming Part of Sentence 9.21.2.5.(1)

Fireplace Opening, m^2	Chimney Height, m							
	3.0 to 4.5		> 4.5 to 5.9		> 5.9 to 8.9		> 8.9 to 12	
	Flue Diameter, mm							
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Up to 0.150	110	170	100	160	90	150	90	150
0.151 to 0.250	150	210	130	190	130	190	120	180
0.251 to 0.350	180	240	160	220	150	210	140	200
0.351 to 0.500	220	280	200	260	190	250	170	230
0.501 to 0.650	260	320	230	290	220	280	200	260
0.651 to 0.800	290	350	260	320	240	300	220	280
0.801 to 1.00	330	390	290	350	270	330	250	310
1.01 to 1.20	360	420	320	380	300	360	270	330
1.21 to 1.40	390	450	350	410	330	390	300	360
1.41 to 1.60	420	480	380	440	350	410	320	380
1.61 to 1.80	—	—	400	460	370	430	340	400
1.81 to 2.00	—	—	—	—	400	460	360	420
2.01 to 2.20	—	—	—	—	—	—	380	440
Column 1	2	3	4	5	6	7	8	9

Table 9.21.2.5.B.
Rectangular Flue Sizes for Fireplace Chimneys
Forming Part of Sentence 9.21.2.5.(1)

Fireplace Opening, m²	Chimney Height, m							
	3.0 to 4.5		> 4.5 to 5.9		> 5.9 to 8.9		> 8.9 to 12	
	Flue Size, mm							
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Up to 0.150	200 × 200	200 × 200	100 × 200	100 × 200	100 × 200	100 × 200	100 × 200	100 × 200
0.151 to 0.250	200 × 200	200 × 200	200 × 200	200 × 200	200 × 200	200 × 200	200 × 200	200 × 200
0.251 to 0.350	200 × 300	200 × 300	200 × 200	200 × 300	200 × 200	200 × 200	200 × 200	200 × 200
0.351 to 0.500	300 × 300	300 × 300	200 × 300	200 × 300	200 × 300	200 × 300	200 × 200	200 × 300
0.501 to 0.650	300 × 300	300 × 400	300 × 300	300 × 300	300 × 300	300 × 300	200 × 300	200 × 300
0.651 to 0.800	300 × 400	300 × 400	300 × 300	300 × 400	300 × 300	300 × 300	300 × 300	300 × 300
0.801 to 1.00	400 × 400	400 × 400	300 × 400	300 × 400	300 × 400	300 × 400	300 × 300	300 × 300
1.01 to 1.20	400 × 400	400 × 400	400 × 400	400 × 400	300 × 400	300 × 400	300 × 400	300 × 400
1.21 to 1.40	—	—	400 × 400	400 × 400	400 × 400	400 × 400	300 × 400	300 × 400
1.41 to 1.60	—	—	—	—	400 × 400	400 × 400	400 × 400	400 × 400
1.61 to 1.80	—	—	—	—	—	—	400 × 400	400 × 400
1.81 to 2.00	—	—	—	—	—	—	400 × 400	400 × 400
Column 1	2	3	4	5	6	7	8	9

9.21.2.6. Oval Chimney Flues

(1) The width of an oval *chimney flue* shall be not less than two-thirds its breadth.

9.21.3. Chimney Lining

9.21.3.1. Lining Materials

(1) Every *masonry or concrete chimney* shall have a lining of clay, concrete, firebrick or metal.

9.21.3.2. Joints in Chimney Liners

(1) Joints of *chimney liners* shall be sealed to provide a barrier to the passage of flue gases and condensate into the cavity between the liner and the surrounding masonry.

(2) Joints of clay, concrete or firebrick *chimney liners* shall be struck flush to provide a straight, smooth, aligned *chimney flue*.

9.21.3.3. Clay Liners

(1) Clay liners shall conform to CAN/CSA-A324-M, "Clay Flue Liners".

(2) Liners referred to in Sentence (1) shall be not less than 15.9 mm thick and shall be capable of resisting, without softening or cracking, a temperature of 1100°C.

9.21.3.4. Firebrick Liners

(1) Firebrick liners shall conform to ASTM C27, "Classification of Fireclay and High Alumina Refractory Brick".

(2) Firebrick liners shall be laid with high temperature cement mortar conforming to CAN/CGSB-10.3, "Air Setting Refractory Mortar".

9.21.3.5. Concrete Liners

(1) Concrete *flue* liners shall conform to Clause 4.2.6.4. of CAN/CSA-A405-M, "Design and Construction of Masonry Chimneys and Fireplaces".

9.21.3.6. Metal Liners

(1) Metal liners shall be constructed of at least 0.3 mm thick stainless steel.

(2) Except as provided in Sentence 9.22.10.2.(3), metal liners referred to in Sentence (1) shall only be used in *chimneys* serving gas- or oil-burning *appliances*. (See Appendix A.)

9.21.3.7. Installation of Chimney Liners

(1) *Chimney liners* shall be installed when the surrounding masonry or concrete is placed.

9.21.3.8. Spaces Between Liners and Surrounding Masonry

(1) A space not less than 10 mm wide shall be left between a *chimney liner* and the surrounding masonry.

(2) The space required in Sentence (1) shall not be filled with mortar.

9.21.3.9. Mortar for Chimney Liners

(1) *Chimney liners* used in *chimneys* for solid fuel-burning *appliances* shall be laid in a full bed of,
(a) high temperature cement mortar conforming to CAN/CGSB-10.3, "Air Setting Refractory Mortar", or
(b) mortar consisting of one part Portland cement to three parts sand by volume.

(2) *Chimney liners* used in *chimneys* for oil- or gas-burning *appliances* shall be laid in a full bed of mortar consisting of one part Portland cement to three parts sand by volume.

9.21.3.10. Extension of Chimney Liners

(1) *Chimney liners* shall extend from a point not less than 200 mm below the lowest *flue pipe* connection to a point not less than 50 mm or more than 100 mm above the *chimney* cap.

9.21.4. Masonry and Concrete Chimney Construction

9.21.4.1. Unit Masonry

(1) Unit masonry shall conform to Section 9.20.

9.21.4.2. Concrete

(1) Concrete shall conform to Section 9.3.

9.21.4.3. Footings

(1) Footings for masonry *chimneys* and concrete *chimneys* shall conform to the requirements in Section 9.15.

9.21.4.4. Height of Chimney Flues

(1) A *chimney flue* shall extend not less than,
(a) 900 mm above the highest point at which the *chimney* comes in contact with the roof, and
(b) 600 mm above the highest roof surface or structure within 3 m of the *chimney*.
(See Appendix A.)

9.21.4.5. Lateral Stability

(1) Except as provided in Sentence (2), *chimneys* shall be braced in accordance with Subsection 4.3.2. to provide stability under wind loads.

(2) A *chimney* need not be laterally braced provided,
(a) no horizontal outside dimension is less than 400 mm, and
(b) the *chimney* extends not more than 3.6 m above a roof or the masonry wall of which it forms a part.
(See Appendix A.)

9.21.4.6. Chimney Caps

(1) The top of a *chimney* shall have a waterproof cap of reinforced concrete, masonry or metal.

(2) The cap required in Sentence (1) shall slope from the lining and be provided with a drip not less than 25 mm from the *chimney* wall.

(3) Cast-in-place concrete caps shall be separated from the *chimney liner* by a bond break and be sealed at that location.

(4) Jointed precast concrete or masonry *chimney* caps shall have flashing installed beneath the cap extending from the liner to the drip edge.

9.21.4.7. Cleanout

(1) Except for a *chimney flue* constructed to serve a masonry fireplace, a cleanout opening with a metal frame and tight-fitting metal door shall be installed near the base of the *chimney flue*.

9.21.4.8. Wall Thickness

(1) The walls of a masonry *chimney* shall be built of solid units not less than 70 mm thick.

9.21.4.9. Separation of Flue Liners

(1) *Flue* liners in the same *chimney* shall be separated by not less than 70 mm of masonry or concrete exclusive of liners where clay liners are used, or 90 mm of firebrick where firebrick liners are used.

(2) *Flue* liners referred to in Sentence (1) shall be installed to prevent significant lateral movement.

9.21.4.10. Flashing

(1) Junctions with adjacent materials shall be adequately flashed to shed water.

9.21.5. Clearance from Combustible Construction

9.21.5.1. Clearance from Combustible Materials

(1) The clearance between *masonry or concrete chimneys* and *combustible* framing material shall be not less than,
(a) 50 mm for interior *chimneys*, and
(b) 12 mm for exterior *chimneys*.
(See Appendix A.)

(2) A clearance of not less than 150 mm shall be provided between a cleanout opening and *combustible* material.

(3) *Combustible* flooring, subflooring and ceiling finishes shall have not less than a 12 mm clearance from *masonry or concrete chimneys*.

9.21.5.2. Sealing of Spaces

(1) All spaces between *masonry or concrete chimneys* and *combustible* material shall be sealed top or bottom with *noncombustible* material.

9.21.5.3. Support of Joists or Beams

(1) Joists or beams may be supported on masonry walls that enclose *chimney flues* provided the *combustible* members are separated from the *flue* by a minimum of 290 mm of solid masonry.

Section 9.22. Fireplaces

9.22.1. General

9.22.1.1. Application

(1) Except as otherwise specifically stated in this Part, this Section applies to masonry fireplaces constructed on site.

9.22.1.2. Masonry and Concrete

(1) Except as otherwise stated in this Section, unit masonry shall conform to Section 9.20. and concrete to Section 9.3.

(2) Masonry above openings shall be supported by steel lintels conforming to Sentence 9.20.5.2.(2), reinforced concrete or a masonry arch.

9.22.1.3. Footings

(1) Footings for masonry and concrete fireplaces shall conform to Section 9.15.

9.22.1.4. Combustion Air

(1) Every solid fuel-fired fireplace, including a factory-built fireplace, shall have a supply of combustion air from outdoors in accordance with Sentences (2) to (7).

(2) The combustion air shall be supplied by a *noncombustible* and corrosion-resistant supply duct.

(3) The supply duct shall have,
(a) a diameter of not less than 100 mm or equivalent area, and
(b) an exterior intake for entry of air from the outdoors.

(4) The supply duct shall contain a tight-fitting damper that shall be located close to the interior outlet and be operable from the room containing the fireplace.

(5) The operating mechanism shall clearly indicate the actual position of the damper.

(6) The interior outlet shall,
(a) be located as close as possible to the opening in the face of the fireplace, and
(b) be designed to prevent embers from entering the supply duct.

(7) Where a supply of combustion air is provided directly to the fire chamber of a fireplace, including a factory-built fireplace or a steel fireplace liner, the installation shall comply with the "Outdoor Air Supply" requirements provided in CAN/CSA-A405-M, "Design and Construction of Masonry Chimneys and Fireplaces".

9.22.2. Fireplace Liners

9.22.2.1. Brick or Steel Liners

(1) Except where a fireplace is equipped with a steel liner, every fireplace shall have a firebrick liner.

9.22.2.2. Firebrick Liners

(1) Fireplace liners shall be not less than,
(a) 50 mm thick for the sides and back, and
(b) 25 mm thick for the floor.

(2) Firebrick liners shall be laid with high temperature cement mortar conforming to CAN/CGSB-10.3, "Air Setting Refractory Mortar".

(3) Joints between a firebrick liner and the adjacent back-up masonry shall be offset.

9.22.2.3. Steel Liners

(1) Steel liners for fireplaces shall conform to CAN/ULC-S639M, "Steel Liner Assemblies for Solid-Fuel Burning Masonry Fireplaces", and shall be installed in accordance with the installation instructions in that standard.

9.22.3. Fireplace Walls

9.22.3.1. Thickness of Walls

(1) Except as provided in Sentence (2), the thickness of the back and sides of a fireplace, including the thickness of any firebrick liner, shall be not less than 190 mm where a metal liner or a firebrick liner less than 51 mm thick is used.

(2) When a steel fireplace liner is used with an air circulating chamber surrounding the firebox, the back and sides of the fireplace shall consist of,
(a) solid masonry units not less than 90 mm thick, or
(b) hollow masonry units not less than 190 mm thick.

9.22.4. Fire Chamber

9.22.4.1. Fire Chamber Dimensions

(1) The distance from the back of the fire chamber to the plane of the fireplace opening shall be not less than 300 mm.

9.22.5. Hearth

9.22.5.1. Hearth Extension

(1) Except as required in Sentence (2), fireplaces shall have a *noncombustible* hearth extending not less than 400 mm in front of the fireplace opening measured from the facing, and not less than 200 mm beyond each side of the fireplace opening.

(2) Where the fire chamber floor is elevated more than 150 mm above the hearth, the dimension of the hearth measured perpendicular to the plane of the fireplace opening shall be increased by not less than,
(a) 50 mm for an elevation above 150 mm and not more than 300 mm, and
(b) an additional 25 mm for every 50 mm in elevation above 300 mm.

9.22.5.2. Support of Hearth

(1) Except as permitted in Sentence (2), the fire chamber floor and hearth shall be supported on a reinforced concrete slab not less than a 100 mm thick at its supports and, if cantilevered, not less than 50 mm thick at its unsupported edge.

(2) A hearth for a fireplace with an opening raised not less than 200 mm from a *combustible* floor is permitted to be supported on that floor provided the requirements of Clauses 5.3.6.5. to 5.3.6.7. of CAN/CSA-A405-M, "Design and Construction of Masonry Chimneys and Fireplaces", are followed.

9.22.6. Damper

9.22.6.1. Required Damper and Size

(1) The throat of every fireplace shall be equipped with a metal damper sufficiently large to cover the full area of the throat opening.

9.22.7. Smoke Chamber

9.22.7.1. Slope of Smoke Chamber

(1) The sides of the smoke chamber connecting a fireplace throat with a *flue* shall not be sloped at an angle greater than 45° to the vertical.

9.22.7.2. Wall Thickness

(1) The thickness of masonry walls surrounding the smoke chamber shall be not less than 190 mm at the sides, front and back, except that the portions of the back exposed to the outside may be 140 mm thick.

9.22.8. Factory-Built Fireplaces

9.22.8.1. Conformance to Standard

(1) Factory-built fireplaces and their installation shall conform to CAN/ULC-S610-M, "Factory-Built Fireplaces".

9.22.9. Clearance of Combustible Material

9.22.9.1. Clearance to the Fireplace Opening

(1) *Combustible* material shall not be placed on or near the face of a fireplace within 150 mm of the fireplace opening, except that where the *combustible* material projects more than 38 mm out from the face of the fireplace above the opening, such material shall be at least 300 mm above the top of the opening.

9.22.9.2. Metal Exposed to the Interior

(1) Metal exposed to the interior of a fireplace such as the damper control mechanism shall have at least a 50 mm clearance from any *combustible* material on the face of the fireplace where such metal penetrates through the face of the fireplace.

9.22.9.3. Clearance to Combustible Framing

(1) Not less than a 100 mm clearance shall be provided between the back and sides of a solid fuel-burning fireplace and *combustible* framing, except that a 50 mm clearance is permitted where the fireplace is located in an exterior wall.

(2) Not less than a 50 mm clearance shall be provided between the back and sides of the smoke chamber of a solid fuel-burning fireplace and *combustible* framing, except that a 25 mm clearance is permitted where the fireplace is located in an exterior wall.

9.22.9.4. Heat Circulating Duct Openings

(1) The clearance of *combustible* material above heat circulating duct openings from those openings shall be not less than,
(a) 300 mm where the *combustible* material projects not less than 38 mm from the face, and
(b) 150 mm where the projection is less than 38 mm.

9.22.10. Fireplace Inserts and Hearth-Mounted Stoves

9.22.10.1. Appliance Standard

(1) Fireplace inserts and hearth mounted *stoves* vented through the throat of a fireplace shall conform to ULC-S628, "Fireplace Inserts".

9.22.10.2. Installation

(1) The installation of fireplace inserts and hearth mounted *stoves* vented through the throat of a fireplace shall conform to CAN/CSA-B365, "Installation Code for Solid-Fuel Burning Appliances and Equipment".

(2) Fireplace inserts and hearth mounted *stoves* vented through the throat of a fireplace described in Sentence (1) may be installed in existing fireplaces only if a minimum thickness of 190 mm of solid masonry is provided between the smoke chamber and any existing *combustible* materials, unless the insert is *listed* for lesser clearances.

(3) A fireplace insert installed in a masonry fireplace shall have,
(a) a *listed* metal *chimney* liner installed from the insert collar to the top of the *chimney*, or
(b) a direct sealed connection to the *chimney flue* where such provision is part of an insert conforming to Sentence 9.22.10.1.(1).

Section 9.23. Wood Frame Construction

9.23.1. Application

9.23.1.1. Limitations (See Appendix A.)

(1) This Section applies where wall, floor and roof planes are generally comprised of lumber frames of small repetitive structural members, or engineered components, and where,
(a) roof and wall planes are clad, sheathed or braced on at least one side,
(b) the small repetitive structural members are spaced not more than 610 mm o.c.,
(c) the walls do not serve as *foundations*,
(d) the specified *live load* on supported subfloors and floor framing does not exceed 2.4 kPa, and
(e) the span of any structural member does not exceed 12.20 m.
(See Appendix A.)

(2) Where the conditions in Sentence (1) are exceeded for wood construction, the design of the framing and fastening shall conform to Subsection 4.3.1.

9.23.2. General

9.23.2.1. Strength and Rigidity

(1) All members shall be so framed, anchored, fastened, tied and braced to provide the necessary strength and rigidity.

9.23.2.2. Protection from Decay

(1) Ends of wood joists, beams and other members framing into masonry or concrete shall be treated to prevent decay where the bottom of the member is at or below ground level, or a 12 mm air space shall be provided at the end and sides of the member.

(2) Air spaces required in Sentence (1) shall not be blocked by insulation, *vapour barriers* or air tight materials.

9.23.2.3. Protection from Dampness

(1) Except as permitted in Sentence (2), wood framing members that are not pressure-treated with a wood preservative and that are supported on concrete in contact with the ground or *fill* shall be separated from the concrete by not less than 0.05 mm polyethylene film or Type S roll roofing.

(2) Dampproofing material referred to in Sentence (1) is not required where the wood member is at least 150 mm above the ground.

9.23.2.4. Lumber

(1) Lumber shall conform to the appropriate requirements in Subsection 9.3.2.

9.23.2.5. Termite Protection

(1) Where termites are known to exist, unless pressure-treated with a chemical that is toxic to such termites in accordance with Article 9.3.2.9., wood steps shall rest on a non-cellulosic base or apron extending at least 150 mm above the ground.

(2) Wood lattice or skirting around porches shall be separated from piers and *soil* by at least 50 mm.

9.23.3. Fasteners

9.23.3.1. Standards for Nails and Screws

(1) Except as provided in Sentence (2) and elsewhere in this Part, nails specified in this Section shall be common steel wire nails or common spiral nails, conforming to,
(a) ASTM F1667, "Driven Fasteners: Nails, Spikes and Staples", or
(b) CSA B111, "Wire Nails, Spikes and Staples".

(2) Nails used to comply with Table 9.23.3.4. shall have a diameter not less than that required by Table 9.23.3.1.

(3) Wood screws specified in this Section shall conform to ANSI/ASME B18.6.1., "Wood Screws (Inch Series)". (See Appendix A.)

Table 9.23.3.1.
Diameter of Nails for Framing
Forming Part of Sentence 9.23.3.1.(2)

Minimum Length of Nails, mm	Minimum Diameter of Nails, mm
57	2.87
62	3.25
76	3.66
82	3.66
101	4.88
Column 1	2

9.23.3.2. Length of Nails

(1) All nails shall be long enough so that not less than half their required length penetrates into the second member.

9.23.3.3. Prevention of Splitting

(1) Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from the edges. (See Appendix A.)

9.23.3.4. Nailing of Framing

(1) Except as provided in Sentence (2), nailing of framing shall conform to Table 9.23.3.4.

(2) Where the bottom wall plate or sole plate of an exterior wall is not nailed to joists or blocking in conformance with Table 9.23.3.4., the exterior wall may be fastened to the floor framing by,
(a) having plywood, OSB or waferboard sheathing extend down over floor framing and fastened to the floor framing by nails or staples conforming to Article 9.23.3.5., or
(b) tying the wall framing to the floor framing by 50 mm wide galvanized-metal strips,
  (i) not less than 0.41 mm in thickness,
  (ii) spaced not more than 1.2 m apart, and
  (iii) fastened at each end with at least two 63 mm nails.

Table 9.23.3.4.
Nailing for Framing
Forming Part of Sentence 9.23.3.4.(1)

Construction Detail	Minimum Length of Nails, mm	Minimum Number or Maximum Spacing of Nails
Floor joist to plate – toe nail	82	2
Wood or metal strapping to underside of floor joists	57	2
Cross bridging to joists	57	2 at each end
Double header or trimmer joists	76	300 mm (o.c.)
Floor joist to stud (balloon construction)	76	2
Ledger strip to wood beam	82	2 per joist
Joist to joist splice (See also Table 9.23.13.8.)	76	2 at each end
Header joist end nailed to joists along perimeter	101	3
Tail joist to adjacent header joist (end nailed) around openings	82	5
	101	3
Each header joist to adjacent trimmer joist (end nailed) around openings	82	5
	101	3
Stud to wall plate (each end) toe nail	62	4
or end nail	82	2
Doubled studs at openings, or studs at walls or wall intersections and corners	76	750 mm (o.c.)
Doubled top wall plates	76	600 mm (o.c.)
Bottom wall plate or sole plate to joists or blocking (exterior walls)(1)	82	400 mm (o.c.)
Interior walls to framing or subflooring	82	600 mm (o.c.)
Horizontal member over openings in non-loadbearing walls – each end	82	2
Lintels to studs	82	2 at each end
Ceiling joist to plate – toe nail each end	82	2
Roof rafter, roof truss or roof joist to plate – toe nail	82	3
Rafter plate to each ceiling joist	101	2
Rafter to joist (with ridge supported)	76	3
Rafter to joist (with ridge unsupported)	76	See Table 9.23.13.8.
Gusset plate to each rafter at peak	57	4
Rafter to ridge board – toe nail – end nail	82	3
Collar tie to rafter – each end	76	3
Collar tie lateral support to each collar tie	57	2
Jack rafter to hip or valley rafter	82	2
Roof strut to rafter	76	3
Roof strut to loadbearing wall – toe nail	82	2
38 mm × 140 mm or less plank decking to support	82	2
Plank decking wider than 38 mm × 140 mm to support	82	3
38 mm edge laid plank decking to support (toe nail)	76	1
38 mm edge laid plank to each other	76	450 mm (o.c.)
Column 1	2	3

Notes to Table 9.23.3.4.:
(1) See Sentence 9.23.3.4.(2).

9.23.3.5. Fastening for Sheathing or Subflooring

(1) Except as required by Sentence (5), fastening of sheathing and subflooring shall conform to Table 9.23.3.5.

(2) Staples shall not be less than 1.6 mm in diameter or thickness, with not less than a 9.5 mm crown driven with the crown parallel to framing.

(3) Roofing nails for the attachment of fibreboard or gypsum sheathing shall not be less than 3.2 mm in diameter with a minimum head diameter of 11.1 mm.

(4) Flooring screws shall not be less than 3.2 mm in diameter.

(5) Where roof sheathing supports are spaced at more than 406 mm o.c., the maximum spacing of fasteners for roof sheathing shall be 150 mm along edges and intermediate supports.

Table 9.23.3.5.
Fasteners for Sheathing and Subflooring
Forming Part of Sentence 9.23.3.5.(1)

Element	Minimum Length of Fasteners, mm				Minimum Number or Maximum Spacing of Fasteners
	Common or Spiral Nails	Ring Thread Nails or Screws	Roofing Nails	Staples	
Board lumber 184 mm or less wide	51	45	N/A	51	2 per support
Board lumber more than 184 mm wide	51	45	N/A	51	3 per support
Fibreboard sheathing up to 13 mm thick	N/A	N/A	44	28	150 mm (o.c.) along edges and 300 mm (o.c.) along intermediate supports
Gypsum sheathing up to 13 mm thick	N/A	N/A	44	N/A	
Plywood, OSB or waferboard up to 10 mm thick	51	45	N/A	38	
Plywood, OSB or waferboard over 10 mm and up to 20 mm thick	51	45	N/A	51	
Plywood, OSB or waferboard over 20 mm and up to 25 mm thick	57	51	N/A	N/A	
Column 1	2	3	4	5	6

9.23.4. Maximum Spans

9.23.4.1. Application

(1) Spans provided in this Subsection for joists, beams and lintels supporting floors shall apply only where,
(a) the floors serve residential areas as described in Table 4.1.5.3., or
(b) the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.5.3.

(2) Spans for joists, beams and lintels supporting floors shall be determined according to Subsection 4.1.3. where the supported floors,
(a) serve other than residential areas, or
(b) support a uniform *live load* in excess of that specified for residential areas.

9.23.4.2. Spans for Joists, Rafters and Beams (See Appendix A.)

(1) Except as required in Sentence (2) and Article 9.23.13.10., the spans for wood joists and rafters shall conform to the spans shown in Tables A-1 to A-7 for the uniform *live loads* shown in the Tables.

(2) Spans for floor joists that are not selected from Tables A-1 and A-2 and that are required to be designed for the same loading conditions, shall not exceed the design requirements for uniform loading and vibration criteria. (See Appendix A.)

(3) Spans for built-up wood and glued-laminated timber floor beams shall conform to the spans in Tables A-8 to A-11.

(4) Spans for roof ridge beams shall conform to the spans in Table A-12 for the uniform snow load shown.

9.23.4.3. Steel Beams

(1) The spans for steel beams with laterally supported top flanges shall conform to Table 9.23.4.3. for floors and Tables A-20 to A-29 for roofs and floors. (See Appendix A.)

(2) Beams described in Sentence (1) shall at least meet the requirements for Grade 350 W steel in CSA G40.21, "General Requirements for Rolled or Welded Structural Quality Steel".

(3) A beam may be considered to be laterally supported if,
(a) the wood joists bear on its top flange at intervals of 610 mm or less over its entire length,
(b) the load being applied to this beam is transmitted through the joists, and
(c) 19 mm by 38 mm wood strips in contact with the top flange are nailed on both sides of the beam to the bottom of the joist supported.

Table 9.23.4.3.
Maximum Spans for Steel Beams Supporting Floors in Dwelling Units[(1)]
Forming Part of Sentence 9.23.4.3.(1)

	Supported Joist Length, m (Half the sum of joist spans on both sides of the beam)						
	2.4	3.0	3.6	4.2	4.8	5.4	6.0
Section	One Storey Supported						
W150 × 22	5.5	5.2	4.9	4.8	4.6	4.5	4.3
W200 × 21	6.5	6.2	5.9	5.7	5.4	5.1	4.9
W200 × 27	7.3	6.9	6.6	6.3	6.1	5.9	5.8
W200 × 31	7.8	7.4	7.1	6.8	6.6	6.4	6.2
W250 × 24	8.1	7.6	7.3	7.0	6.6	6.2	5.9
W250 × 33	9.2	8.7	8.3	8.0	7.7	7.5	7.3
W250 × 39	10.0	9.4	9.0	8.6	8.4	8.1	7.9
W310 × 31	10.4	9.8	9.4	8.9	8.4	8.0	7.6
W310 × 39	11.4	10.7	10.2	9.8	9.5	9.2	9.0
Section	Two Storeys Supported						
W150 × 22	4.9	4.4	4.1	3.8	3.5	3.4	3.2
W200 × 21	5.6	5.1	4.6	4.3	4.1	3.8	3.7
W200 × 27	6.4	6.1	5.6	5.3	4.9	4.7	4.4
W200 × 31	6.9	6.5	6.2	5.8	5.4	5.1	4.9
W250 × 24	6.8	6.1	5.6	5.2	4.9	4.6	4.4
W250 × 33	8.2	7.7	7.0	6.5	6.1	5.8	5.5
W250 × 39	8.8	8.3	7.8	7.2	6.8	6.4	6.1
W310 × 31	8.7	7.8	7.2	6.7	6.2	5.9	5.6
W310 × 39	10.0	9.3	8.5	7.9	7.4	7.0	6.7
Column 1	2	3	4	5	6	7	8

Notes to Table 9.23.4.3.:
(1) See Appendix A.

9.23.4.4. Concrete Topping (See Appendix A.)

(1) Except as permitted in Sentence (2), where a floor is required to support a concrete topping, the joist spans shown in Table A-1 or the spacing of the members shall be reduced to allow for the loads due to the topping.

(2) Where a floor is required to support a concrete topping, joist spans are permitted to be selected from Table A-2 provided the concrete,
(a) is 38 to 51 mm thick,
(b) is normal weight,
(c) is placed directly on the subflooring, and
(d) has not less than 20 MPa compressive strength after 28 days.

(3) Where a floor is required to support a concrete topping not more than 51 mm thick, the beam spans shown in Tables A-8 to A-11 shall be multiplied by 0.8 or the supported length of the floor joists shall be reduced to allow for the loads due to the topping.

9.23.4.5. Heavy Roofing Materials

(1) Where a roof is required to support an additional uniform *dead load* from roofing materials such as concrete roofing tile, or materials other than as specified in Section 9.26., such as clay roofing tiles, the additional load shall be allowed for by reducing,
(a) the spans for roof joists and rafters in Tables A-4 to A-7, or the spacing of the members, and
(b) the spans for ridge beams and lintels in Tables A-12 to A-16.

9.23.5. Notching and Drilling

9.23.5.1. Holes Drilled in Framing Members

(1) Holes drilled in roof, floor or ceiling framing members shall be not larger than one-quarter the depth of the member and shall be located not less than 50 mm from the edges, unless the depth of the member is increased by the size of the hole.

9.23.5.2. Notching of Framing Members

(1) Floor, roof and ceiling framing members are permitted to be notched provided the notch is located on the top of the member within half the joist depth from the edge of bearing and is not deeper than one-third the joist depth, unless the depth of the member is increased by the size of the notch.

9.23.5.3. Wall Studs

(1) Wall studs shall not be notched, drilled or otherwise damaged so that the undamaged portion of the stud is less than two-thirds the depth of the stud if the stud is *loadbearing* or 40 mm if the stud is non-*loadbearing*, unless the weakened studs are suitably reinforced.

9.23.5.4. Top Plates

(1) Top plates in walls shall not be notched, drilled or otherwise weakened to reduce the undamaged width to less than 50 mm unless the weakened plates are suitably reinforced.

9.23.5.5. Roof Trusses

(1) Roof truss members shall not be notched, drilled or otherwise weakened unless such notching or drilling is allowed for in the design of the truss.

9.23.6. Anchorage

9.23.6.1. Anchorage of Building Frames

(1) *Building* frames shall be anchored to the *foundation* unless a structural analysis of wind and earth pressures shows anchorage is not required.

(2) Except as provided in Article 9.23.6.3., anchorage shall be provided by embedding the ends of the first floor joists in concrete, or fastening the sill plate to the *foundation* with not less than 12.7 mm diam anchor bolts spaced not more than 2.4 m o.c.

(3) Anchor bolts referred to in Sentence (2) shall be fastened to the sill plate with nuts and washers and shall be embedded not less than 100 mm in the *foundation* and so designed that they may be tightened without withdrawing them from the *foundation*.

9.23.6.2. Anchorage of Columns and Posts

(1) Except as provided in Sentences (2) and (3), exterior columns and posts shall be anchored to resist uplift and lateral movement.

(2) Except as provided in Sentence (3), where columns or posts support balconies, decks, verandas and other exterior platforms, and the columns or posts extend not more than 600 mm above finished ground level, the supported joists or beams shall be,
(a) anchored to a *foundation* to resist uplift and lateral movement, or
(b) directly anchored to the ground to resist uplift.

(3) Anchorage is not required for platforms described in Sentence (2) that,
(a) are not more than 1 *storey*,
(b) are not more than 55 m^2 in area,
(c) do not support a roof, and
(d) are not attached to another structure, unless it can be demonstrated that differential movement will not adversely affect the performance of that structure.

9.23.6.3. Anchorage of Smaller Buildings

(1) *Buildings* not more than 4.3 m wide and not more than 1 *storey* in *building height* are permitted to be anchored in conformance with the requirements of CSA Z240.10.1, "Site Preparation, Foundation and Anchorage of Manufactured Homes".

9.23.7. Sill Plates

9.23.7.1. Size of Sill Plates

(1) Where sill plates provide bearing for the floor system they shall be not less than 38 mm by 89 mm material.

9.23.7.2. Levelling of Sill Plates

(1) Sill plates shall be,
(a) levelled by setting them on a full bed of mortar, or
(b) laid directly on the *foundation* where the top of the *foundation* is level.

(2) The joint between the sill plate for exterior walls and the *foundation* shall be sealed in accordance with Subsection 9.25.3.

9.23.8. Beams to Support Floors

9.23.8.1. Bearing for Beams

(1) Beams shall have even and level bearing and shall have not less than 89 mm length of bearing at end supports, except as required in notes to Tables A-8 to A-11.

9.23.8.2. Priming of Steel Beams

(1) Exterior steel beams susceptible to corrosion shall be shop primed with rust-inhibitive paint.

9.23.8.3. Built-up Wood Beams (See Appendix A.)

(1) Where a beam is made up of individual pieces of lumber that are nailed together, the individual members shall be 38 mm or greater in thickness and installed on edge.

(2) Except as permitted in Sentence (3), where individual members of a built-up beam are butted together to form a joint, the joint shall occur over a support.

(3) Where a beam is continuous over more than one span, individual members are permitted to be butted together to form a joint at or within 150 mm of the end quarter points of the clear spans, provided the quarter points are not those closest to the ends of the beam.

(4) Members joined at quarter points shall be continuous over adjacent supports.

(5) Joints in individual members of a beam that are located at or near the end quarter points shall not occur in adjacent members at the same quarter point and shall not reduce the effective beam width by more than half.

(6) Not more than one butt joint shall occur in any individual member of a built-up beam within any one span.

(7) Except as provided in Sentence (8), where 38 mm members are laid on edge to form a built-up beam, individual members shall be nailed together with a double row of nails not less than 89 mm in length, spaced not more than 450 mm apart in each row with the end nails located 100 mm to 150 mm from the end of each piece.

(8) Where 38 mm members in built-up wood beams are not nailed together as provided in Sentence (7), they shall be bolted together with not less than 12.7 mm diam bolts equipped with washers and spaced not more than 1.2 m o.c., with the end bolts located not more than 600 mm from the ends of the members.

9.23.9. Floor Joists

9.23.9.1. End Bearing for Joists

(1) Except when supported on ribbon boards, floor joists shall have not less than 38 mm length of end bearing.

(2) Ribbon boards referred to in Sentence (1) shall be not less than 19 mm by 89 mm lumber let into the studs.

9.23.9.2. Joists Supported by Beams

(1) Floor joists may be supported on the tops of beams or may be framed into the sides of beams.

(2) When framed into the side of a wood beam, joists referred to in Sentence (1) shall be supported on,
(a) joist hangers or other acceptable mechanical connectors, or
(b) not less than 38 mm by 64 mm ledger strips nailed to the side of the beam, except that 38 mm by 38 mm ledger strips may be used provided each joist is nailed to the beam by at least four 89 mm nails, in addition to the nailing for the ledger strip required in Table 9.23.3.4.

(3) When framed into the side of a steel beam, joists referred to in Sentence (1) shall be supported on the bottom flange of the beam or on not less than 38 mm by 38 mm lumber bolted to the web with not less than 6.3 mm diam bolts spaced not more than 600 mm apart.

(4) Joists referred to in Sentence (3) shall be spliced above the beam with not less than 38 mm by 38 mm lumber at least 600 mm long to support the flooring.

(5) Not less than a 12 mm space shall be provided between the splice required in Sentence (4) and the beam to allow for shrinkage of the wood joists.

9.23.9.3. Restraint of Joist Bottoms

(1) Except as provided in Sentence 9.23.9.4.(1), bottoms of floor joists shall be restrained from twisting at each end by toe-nailing to the supports, end-nailing to the header joists or by providing continuous strapping, blocking between the joists or cross-bridging near the supports.

9.23.9.4. Strapping and Bridging in Tables A-1 and A-2

(1) Except as permitted by Sentence (5), where strapping is specified in Table A-1, it shall be,
(a) not less than 19 mm by 64 mm, nailed to the underside of floor joists,
(b) located not more than 2.1 m from each support or other rows of strapping, and
(c) fastened at each end to a sill or header.

(2) Where bridging is specified in Table A-1, it shall consist of not less than 19 mm by 64 mm or 38 mm by 38 mm cross bridging located not more than 2.1 m from each support or other rows of bridging.

(3) Where bridging and strapping are specified in Table A-1,
(a) bridging shall,
 (i) comply with Sentence (2), or
 (ii) consist of 38 mm solid blocking located not more than 2.1 m from each support or other rows of bridging and securely fastened between the joists, and
(b) except as provided in Sentence (5), strapping shall comply with Sentence (1) and be installed under the bridging.

(4) Bridging specified in Table A-2 shall consist of,
(a) bridging as described in Sentence (2), or
(b) 38 mm solid blocking located not more than 2.1 m from each support or other rows of bridging and securely fastened between the joists.

(5) Strapping described in Sentence (1) and Clause (3)(b) is not required where,
(a) furring strips complying with Table 9.29.3.1. are fastened directly to the joists, or
(b) a panel-type ceiling finish complying with Subsection 9.29.5., 9.29.6., 9.29.7., 9.29.8., or 9.29.9. is attached directly to the joists.

(6) Where a ceiling attached to wood furring is specified in Table A-2,
(a) the ceiling finish shall consist of gypsum board, plywood or OSB not less than 12.7 mm thick, and
(b) the furring shall be,
 (i) 19 mm by 89 mm wood furring spaced at not more than 610 mm o.c., or
 (ii) 19 mm by 64 mm wood furring spaced at not more than 406 mm o.c.

9.23.9.5. Header Joists

(1) Header joists around floor openings shall be doubled when they exceed 1.2 m in length.

(2) The size of header joists exceeding 3.2 m in length shall be determined by calculations.

9.23.9.6. Trimmer Joists

(1) Trimmer joists around floor openings shall be doubled when the length of the header joist exceeds 800 mm.

(2) When the header joist exceeds 2 m in length, the size of the trimmer joists shall be determined by calculations.

9.23.9.7. Support of Tail and Header Joists

(1) When tail joists and header joists are supported by the floor framing, they shall be supported by suitable joist hangers or nailing in accordance with Table 9.23.3.4.

9.23.9.8. Support of Walls

(1) Non-*loadbearing* walls parallel to the floor joists shall be supported by joists beneath the wall or on blocking between the joists.

(2) Blocking referred to in Sentence (1) for the support of non-*loadbearing* walls shall be not less than 38 mm by 89 mm lumber, spaced not more than 1.2 m apart.

(3) Non-*loadbearing* interior walls at right angles to the floor joists are not restricted as to location.

(4) *Loadbearing* interior walls parallel to floor joists shall be supported by beams or walls of sufficient strength to transfer safely the design loads to vertical supports.

(5) *Loadbearing* interior walls at right angles to floor joists shall be located not more than 900 mm from the joist support when the wall does not support a floor, and not more than 600 mm from the joist support when the wall supports one or more floors, unless the joist size is designed to support such loads.

9.23.9.9. Cantilevered Floor Joists

(1) Floor joists supporting roof loads shall not be cantilevered more than 400 mm beyond their supports where 38 mm by 184 mm joists are used and not more than 600 mm beyond their supports where 38 mm by 235 mm or larger joists are used.

(2) The cantilevered portions referred to in Sentence (1) shall not support floor loads from other *storeys* unless calculations are provided to show that the design resistances of the cantilevered joists are not exceeded.

(3) Where cantilevered floor joists described in Sentences (1) and (2) are at right angles to the main floor joists, the tail joists in the cantilevered portion shall,
(a) extend inward away from the cantilever support a distance equal to not less than six times the length of the cantilever, and
(b) shall be end nailed to an interior doubled header joist in conformance with Table 9.23.3.4.

9.23.10. Wall Studs

9.23.10.1. Stud Size and Spacing

(1) Except as provided in Sentence (2), the size and spacing of studs shall conform to Table 9.23.10.1.

Table 9.23.10.1.
Size and Spacing of Studs
Forming Part of Sentence 9.23.10.1.(1)

Type of Wall	Supported Loads (including dead loads)	Minimum Stud Size, mm	Maximum Stud Spacing, mm	Maximum Unsupported Height, m
Interior	No load	38 × 38	406	2.4
		38 × 89 flat[(1)]	406	3.6
	Attic not accessible by a stairway	38 × 64	610	3.0
		38 × 64 flat[(1)]	406	2.4
		38 × 89	610	3.6
		38 × 89 flat[(1)]	406	2.4
	Attic accessible by a stairway plus 1 floor Roof load plus 1 floor Attic not accessible by stairway plus 2 floors	38 × 89	406	3.6
	Roof load, Attic accessible by a stairway Attic not accessible by a stairway plus 1 floor			
		38 × 64	406	2.4
		38 × 89	610	3.6
	Attic accessible by a stairway plus 2 floors Roof load plus 2 floors	38 × 89	305	3.6
		64 × 89	406	3.6
		38 × 140	406	4.2
	Attic accessible by a stairway plus 3 floors Roof load plus 3 floors	38 × 140	305	4.2
Exterior	Roof with or without attic storage	38 × 64	406	2.4
		38 × 89	610	3.0
	Roof with or without attic storage plus 1 floor	38 × 89	406	3.0
		38 × 140	610	3.0
	Roof with or without attic storage plus 2 floors	38 × 89	305	3.0
		64 × 89	406	3.0
		38 × 140	406	3.6
	Roof with or without attic storage plus 3 floors	38 × 140	305	1.8
Column 1	2	3	4	5

Notes to Table 9.23.10.1.:
(1) See Article 9.23.10.3.

(2) Studs for walls not listed in Table 9.23.10.1. and supporting roof loads shall conform to Tables A-30 to A-33, provided,
(a) the studs are clad with not less than 9.5 mm thick plywood, OSB or waferboard sheathing on the exterior face, and not less than 12.5 mm gypsum board on the interior face,
(b) solid bridging is provided at not more than 1.2 m o.c,
(c) the studs are fastened to the top and bottom plates with no fewer than three 82 mm toe-nails,
(d) the double top plates are fastened together with not less than 76 mm nails spaced not more than 200 mm o.c,
(e) roof framing members spaced not more than 610 mm are fastened to the top plates with no fewer than four 82 mm toe-nails, and
(f) the bottom plate is fastened to the floor joists, blocking or rim joist with not less than 82 mm nails spaced not more than 200 mm o.c.
(See Appendix A.)

9.23.10.2. Bracing and Lateral Support (See Appendix A.)

(1) Except as provided in Sentence (2), each exterior wall in each *storey* shall be braced with at least one diagonal brace conforming to Sentence (3).

(2) Bracing is not required where the walls,
(a) have an interior finish conforming to the requirements of Section 9.29., or
(b) where the walls are,
  (i) clad with panel-type siding,
  (ii) diagonally sheathed with lumber, or
  (iii) sheathed with plywood, OSB, waferboard, gypsum or fibreboard sheathing.

(3) Where bracing is required, it shall,
(a) consist of not less than 19 mm by 89 mm wood members,
(b) be applied to the studs at an angle of approximately 45° to the horizontal, and
(c) extend the full height of the wall on each *storey*.

(4) Bracing described in Sentence (3) shall be nailed to each stud and wall plate by at least two 63 mm nails.

(5) Where *loadbearing* interior walls are not finished in accordance with Sentence (2), blocking or strapping shall be fastened to the studs at mid-height to prevent sideways buckling.

9.23.10.3. Orientation of Studs

(1) Except as permitted in Sentences (2) and (3), all studs shall be placed at right angles to the wall face.

(2) Studs on the flat are permitted to be used in gable ends of roofs that contain only unfinished space or in non-*loadbearing* interior walls within the limits described in Article 9.23.10.1.

(3) Wall studs that support only a load from an attic not accessible by a stairway are permitted to be placed on the flat within the limits permitted in Article 9.23.10.1. provided,
(a) the studs are clad on at least one side with plywood, OSB or waferboard sheathing fastened to the face of the studs with a structural adhesive, and
(b) the portion of the roof supported by the studs does not exceed 2.1 m in width.

9.23.10.4. Continuity of Studs

(1) Wall studs shall be continuous for the full *storey* height except at openings and shall not be spliced except by finger-jointing with a structural adhesive. (See Appendix A.)

9.23.10.5. Support for Cladding Materials

(1) Corners and intersections shall be designed to provide adequate support for the vertical edges of interior finishes, sheathing and cladding materials, and in no instance shall exterior corners be framed with less than the equivalent of two studs.

(2) Where the vertical edges of interior finishes at wall intersections are supported at vertical intervals by blocking or furring, the vertical distance between such supports shall not exceed the maximum distance between supports specified in Section 9.29.

9.23.10.6. Studs at Sides of Openings

(1) Except as provided in Sentence (2), studs shall be doubled on each side of openings so that the inner studs extend from the lintel to the bottom wall plate and the outer studs extend from the top wall plates to the bottom wall plate.

(2) Single studs are permitted to be used on either side of openings,
(a) in non-*loadbearing* interior walls not required to have *fire-resistance ratings*, provided the studs extend from the top wall plate to the bottom wall plate, or
(b) in *loadbearing* or non-*loadbearing* interior or exterior walls, provided,
(i) the opening is less than and within the required stud spacing, and
(ii) no two such openings of full stud space width are located in adjacent stud spaces.
(See Appendix A.)

9.23.10.7. Stud Posts Built into Walls

(1) Except as provided in Sentences (2) and (3), stud posts shall be designed in accordance with Part 4.

(2) The number of studs in a wall directly below a girder truss or roof beam shall conform to Tables A-34 to A-37, provided,
(a) the studs are fastened together to form a post in accordance with Sentence 9.17.4.2.(2),
(b) the wall is not less than 1.2 m long and sheathed on at least one side with plywood, OSB, waferboard or gypsum sheathing, and
(c) the wall sheathing is fastened to the stud post with at least one row of fasteners conforming to Article 9.23.3.5. and spaced not more than 150 mm o.c.
(See Appendix A.)

(3) The width of the stud post shall be not less than the width of the girder or beam that it supports.

9.23.11. Wall Plates

9.23.11.1. Size of Wall Plates

(1) Except as provided in Sentence (2), wall plates shall be,
(a) not less than 38 mm thick, and
(b) not less than the required width of the wall studs.

(2) In non-*loadbearing* walls and in *loadbearing* walls where the studs are located directly over framing members, the bottom wall plate may be 19 mm thick.

9.23.11.2. Bottom Wall Plates

(1) A bottom wall plate shall be provided in all cases.

(2) The bottom plate in exterior walls shall not project more than one-third the plate width over the support.

9.23.11.3. Top Plates

(1) Except as permitted in Sentences (2) to (4), no fewer than two top plates shall be provided in *loadbearing* walls.

(2) A single top plate is permitted to be used in a section of a *loadbearing* wall containing a lintel provided the top plate forms a tie across the lintel.

(3) A single top plate is permitted to be used in *loadbearing* walls where the concentrated loads from ceilings, floors and roofs are not more than 50 mm to one side of the supporting studs and in all non-*loadbearing* walls.

(4) The top plates need not be provided in a section of *loadbearing* wall containing a lintel provided the lintel is tied to the adjacent wall section with,
(a) not less than 75 mm by 150 mm by 0.91 mm thick galvanized steel, or
(b) 19 mm by 89 mm by 300 mm wood splice nailed to each wall section with at least three 63 mm nails.

9.23.11.4. Joints in Top Plates

(1) Joints in the top plates of *loadbearing* walls shall be staggered not less than one stud spacing.

(2) The top plates in *loadbearing* walls shall be lapped or otherwise suitably tied at corners and intersecting walls in accordance with Sentence (4).

(3) Joints in single top plates used with *loadbearing* walls shall be tied in accordance with Sentence (4).

(4) Ties referred to in Sentences (2) and (3) shall be the equivalent of not less than 75 mm by 150 mm by 0.91 mm thick galvanized steel nailed to each wall with at least three 63 mm nails.

9.23.12. Framing Over Openings

9.23.12.1. Openings in Non-Loadbearing Walls

(1) Except as provided in Sentence (2), openings in non-*loadbearing* walls shall be framed with not less than 38 mm material the same width as the studs securely nailed to adjacent studs.

(2) Openings for doors in *non-loadbearing* walls required to be *fire separations* with a *fire-resistance rating* shall be framed with the equivalent of at least two 38 mm thick members that are the same width as the wall plates.

9.23.12.2. Openings in Loadbearing Walls

(1) Openings in *loadbearing* walls greater than the required stud spacing shall be framed with lintels designed to carry the superimposed loads to adjacent studs.

(2) Except as provided in Sentence 9.23.12.3.(2), where two or more members are used in lintels, they shall be fastened together with not less than 82 mm nails in a double row, with nails not more than 450 mm apart in each row.

(3) Lintel members may be separated by filler pieces.

9.23.12.3. Lintel Spans and Sizes

(1) Spans and sizes of wood lintels shall conform to the spans shown in Tables A-12 to A-16,
(a) for *buildings* of *residential occupancy*,
(b) where the wall studs exceed 38 mm by 64 mm in size,
(c) where the spans of supported joists do not exceed 4.9 m, and
(d) where the spans of trusses do not exceed 9.8 m.

(2) In *loadbearing* exterior and interior walls of 38 mm by 64 mm framing members, lintels shall consist of,
(a) solid 64 mm thick members on edge, or
(b) 38 mm thick and 19 mm thick members fastened together with a double row of nails not less than 63 mm long and spaced not more than 450 mm apart.

(3) Lintels referred to in Sentence (2),
(a) shall be not less than 50 mm greater in depth than those shown in Tables A-12 to A-16 for the maximum spans shown, and
(b) shall not exceed 2.24 m in length.

9.23.13. Roof and Ceiling Framing

9.23.13.1. Continuity of Rafters and Joists

(1) Roof rafters and joists and ceiling joists shall be continuous or shall be spliced over vertical supports that extend to suitable bearing.

9.23.13.2. Framing Around Openings

(1) Roof and ceiling framing members shall be doubled on each side of openings greater than two rafter or joist spacings wide.

9.23.13.3. End Bearing Length

(1) The length of end bearing of joists and rafters shall be not less than 38 mm.

9.23.13.4. Location and Attachment of Rafters

(1) Rafters shall be located directly opposite each other and tied together at the peak, or may be offset by their own thickness if nailed to a ridge board not less than 17.5 mm thick.

(2) Except as permitted in Sentence (3), framing members shall be connected by gusset plates or nailing at the peak in conformance with Table 9.23.3.4.

(3) Where the roof framing on opposite sides of the peak is assembled separately, such as in the case of factory-built houses, the roof framing on opposite sides is permitted to be fastened together with galvanized-steel strips not less than 200 mm by 75 mm by 0.41 mm thick spaced not more than 1.2 m apart and nailed at each end to the framing by at least two 63 mm nails.

9.23.13.5. Shaping of Rafters

(1) Rafters shall be shaped at supports to provide even bearing surfaces and supported directly above the exterior walls.

9.23.13.6. Hip and Valley Rafters

(1) Hip and valley rafters shall be not less than 50 mm greater in depth than the common rafters and not less than 38 mm thick, actual dimension.

9.23.13.7. Intermediate Support for Rafters and Joists

(1) Ceiling joists and collar ties of not less than 38 mm by 89 mm lumber are permitted to be assumed to provide intermediate support to reduce the span for rafters and joists where the roof slope is 1 in 3 or greater.

(2) Collar ties referred to in Sentence (1) more than 2.4 m long shall be laterally supported near their centres by not less than 19 mm by 89 mm continuous members at right angles to the collar ties.

(3) Dwarf walls and struts may be used to provide intermediate support to reduce the span for rafters and joists.

(4) When struts are used to provide intermediate support, they shall be not less than 38 mm by 89 mm material extending from each rafter to a *loadbearing* wall at an angle of not less than 45° to the horizontal.

(5) When dwarf walls are used for rafter support, they shall be framed in the same manner as *loadbearing* walls and securely fastened top and bottom to the roof and ceiling framing to prevent overall movement.

(6) Solid blocking shall be installed between floor joists beneath dwarf walls referred to in Sentence (5) that enclose finished rooms.

9.23.13.8. Ridge Support

(1) Except as provided in Sentence (4), roof rafters and joists shall be supported at the ridge of the roof by,
(a) a *loadbearing* wall extending from the ridge to suitable bearing, or
(b) a ridge beam supported by not less than 89 mm length of bearing.

(2) Except as provided in Sentence (3), the ridge beam referred to in Sentence (1) shall conform to the sizes and spans shown in Table A-12, provided,
(a) the supported rafter or joist length does not exceed 4.9 m, and
(b) the roof does not support any concentrated loads.

(3) The ridge beam referred to in Sentence (1) need not comply with Sentence (2) where,
(a) the beam is of not less than 38 mm by 140 mm material, and
(b) the beam is supported at intervals not exceeding 1.2 m by not less than 38 mm by 89 mm members extending vertically from the ridge to suitable bearing.

(4) When the roof slope is 1 in 3 or more, ridge support need not be provided when the lower ends of the rafters are adequately tied to prevent outward movement.

(5) Ties required in Sentence (4) are permitted to consist of tie rods or ceiling joists forming a continuous tie for opposing rafters and nailed in accordance with Table 9.23.13.8.

(6) Ceiling joists referred to in Sentence (5) shall be fastened together with at least one more nail per joist splice than required for the rafter to joist connection shown in Table 9.23.13.8.

(7) Members referred to in Sentence (6) are permitted to be fastened together either directly or through a gusset plate.

Table 9.23.13.8.
Rafter-to-Joist Nailing (Unsupported Ridge)
Forming Part of Sentences 9.23.13.8.(5) and (6)

Roof Slope	Rafter Spacing, mm	Minimum Number of Nails not less than 75 mm Long											
		Rafter Tied to every Joist						Rafter Tied to Joist every 1.2 m					
		Building Width up to 8.0 m			Building Width up to 9.8 m			Building Width up to 8.0 m			Building Width up to 9.8 m		
		Roof Snow Load, kPa			Roof Snow Load, kPa			Roof Snow Load, kPa			Roof Snow Load, kPa		
		1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more
1 in 3	406	4	5	6	5	7	8	11	—	—	—	—	—
	610	6	8	9	8	—	—	11	—	—	—	—	—
1 in 2.4	406	4	4	5	5	6	7	7	10	—	9	—	—
	610	5	7	8	7	9	11	7	10	—	—	—	—
1 in 2	406	4	4	4	4	4	5	6	8	9	8	—	—
	610	4	5	6	5	7	8	6	8	9	8	—	—
1 in 1.71	406	4	4	4	4	4	4	5	7	8	7	9	11
	610	4	4	5	5	6	7	5	7	8	7	9	11
1 in 1.33	406	4	4	4	4	4	4	4	5	6	5	6	7
	610	4	4	4	4	4	5	4	5	6	5	6	7
1 in 1	406	4	4	4	4	4	4	4	4	4	4	4	5
	610	4	4	4	4	4	4	4	4	4	4	4	5
Col. 1	2	3	4	5	6	7	8	9	10	11	12	13	14

9.23.13.9. Restraint of Joist Bottoms

(1) Roof joists supporting a finished ceiling, other than plywood, OSB or waferboard, shall be restrained from twisting along the bottom edges by means of furring, blocking, cross bridging or strapping conforming to Article 9.23.9.3.

9.23.13.10. Ceiling Joists Supporting Roof Load

(1) Except as provided in Sentence (2), ceiling joists supporting part of the roof load from the rafters shall be not less than 25 mm greater in depth than required for ceiling joists not supporting part of the roof load.

(2) When the roof slope is 1 in 4 or less, the ceiling joist sizes referred to in Sentence (1) shall be determined from the span tables for roof joists.

9.23.13.11. Wood Roof Trusses

(1) Roof trusses that are not designed in accordance with Part 4 shall,

(a) be capable of supporting a total ceiling load (*dead load* plus *live load*) of 0.35 kPa plus two and two-thirds times the specified live roof load for 24 h, and

(b) not exceed the deflections shown in Table 9.23.13.11. when loaded with the ceiling load plus one and one-third times the specified roof snow load for 1 h.

Table 9.23.13.11.
Maximum Roof Truss Deflections
Forming Part of Sentence 9.23.13.11.(1)

Truss Span	Type of Ceiling	Maximum Deflection
4.3 m or less	Plaster or gypsum board	1/360 of the span
	Other than plaster or gypsum board	1/180 of the span
Over 4.3 m	Plaster or gypsum board	1/360 of the span
	Other than plaster or gypsum board	1/240 of the span
Column 1	2	3

(2) The joint connections used in trusses described in Sentence (1) shall be designed in conformance with the requirements in Subsection 4.3.1. (See Appendix A.)

(3) Where the length of compression web members in roof trusses described in Sentence (1) exceeds 1.83 m, such web members shall be provided with continuous bracing to prevent buckling.

(4) Bracing required in Sentence (3) shall consist of not less than 19 mm by 89 mm lumber nailed at right angles to the web members near their centres with at least two 63 mm nails for each member.

(5) Where the ability of a truss design to satisfy the requirements of Sentence (1) is demonstrated by testing, it shall consist of a full scale load test carried out in conformance with CSA S307-M, "Load Test Procedure for Wood Trusses for Houses and Small Buildings".

(6) Where the ability of a truss design to satisfy the requirements of Sentence (1) is demonstrated by analysis, it shall be carried out in accordance with good engineering practice such as described in TPIC, "Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses".

9.23.14. Subflooring

9.23.14.1. Subflooring Required

(1) Subflooring shall be provided beneath finish flooring where the finish flooring does not have adequate strength to support the design loads.

9.23.14.2. Material Standards

(1) Except as provided in Sentence (2), wood-based panels for subfloors shall conform to,
(a) CSA O121, "Douglas Fir Plywood",
(b) CSA O151, "Canadian Softwood Plywood",
(c) CSA O153-M, "Poplar Plywood",
(d) CAN/CSA-O325.0, "Construction Sheathing", or
(e) CSA O437.0, "OSB and Waferboard".

(2) Particleboard subflooring may be used only where a *building* is constructed in a factory so that the subfloor will not be exposed to the weather.

(3) Subflooring described in Sentence (2) shall conform to grade D-2 or D-3 in ANSI A208.1, "Particleboard".

(4) Subflooring described in Sentence (2) shall have its upper surface and all edges treated to restrict water absorption where the subfloor is used in bathrooms, kitchens, laundry rooms or other areas subject to periodic wetting. (See Appendix A.)

9.23.14.3. Edge Support

(1) Where the edges of panel-type subflooring are required to be supported, such support shall consist of tongue-and-groove panel edges or not less than 38 mm by 38 mm blocking securely nailed between framing members.

9.23.14.4. Direction of Installation

(1) Plywood subflooring shall be installed with the surface grain at right angles to the joists and with joints parallel to floor joists staggered.

(2) OSB subflooring conforming to CAN/CSA-O325.0, "Construction Sheathing", or to O-1 and O-2 grades in CSA O437.0, "OSB and Waferboard", and waferboard subflooring conforming to R-1 grade in CSA O437.0 shall be installed so that the direction of face orientation is at right angles to the joists and the joints parallel to the floor joists are staggered. (See Appendix A.)

9.23.14.5. Subfloor Thickness or Rating

(1) Except as provided in Sentences (2) and (3), subfloors shall conform to Table 9.23.14.5.A. or 9.23.14.5.B.

Table 9.23.14.5.A.
Thickness of Subflooring
Forming Part of Sentences 9.23.14.5.(1) and 9.23.15.7.(1)

Maximum Spacing of Supports, mm	Minimum Thickness, mm			
	Plywood and OSB, O-2 Grade	OSB, O-1 Grade, and Waferboard, R-1 Grade	Particleboard	Lumber
406	15.5	15.9	15.9	17.0
508	15.5	15.9	19.0	19.0
610	18.5	19.0	25.4	19.0
Column 1	2	3	4	5

Table 9.23.14.5.B.
Rating for Subfloor when Applying CAN/CSA-O325.0
Forming Part of Sentences 9.23.14.5.(1) and 9.23.15.7.(1)

Maximum Spacing of Supports, mm	Panel Mark	
	Subfloor	Used with Panel-Type Underlay
406	1F16	2F16
508	1F20	2F20
610	1F24	2F24
Column 1	2	3

(2) Where the finished flooring consists of not less than 19 mm matched wood strip flooring laid at right angles to joists, spaced not more than 610 mm o.c., subflooring shall be permitted to consist of not less than,
(a) 12.5 mm thick plywood,
(b) 12.5 mm thick OSB conforming to O-2 grade,
(c) 12.7 mm thick OSB conforming to O-1 grade,
(d) 12.7 mm thick waferboard conforming to R-1 grade, or
(e) OSB conforming to 2R32 / 2F16 grade.

(3) Except where the flooring consists of ceramic tiles applied with adhesive, where a separate panel-type underlay or concrete topping is applied to a subfloor on joists spaced not more than 406 mm o.c., the subfloor may consist of not less than,
(a) 12.5 mm thick plywood,
(b) 12.5 mm thick OSB conforming to O-2 grade,
(c) 12.7 mm thick OSB conforming to O-1 grade,
(d) 12.7 mm thick waferboard conforming to R-1 grade, or
(e) OSB conforming to 2R32 / 2F16 grade.

9.23.14.6. Annular Grooved Nails

(1) When resilient flooring is applied directly to an OSB, waferboard, particleboard or plywood subfloor, the subfloor shall be fastened to the supports with annular grooved nails.

9.23.14.7. Lumber Subflooring

(1) Lumber subflooring shall be laid at an angle of not less than 45° to the joists.

(2) Lumber subflooring shall be fully supported at the ends on solid bearing.

(3) Lumber for subflooring shall be of uniform thickness and not more than 184 mm wide.

9.23.15. Roof Sheathing

9.23.15.1. Required Roof Sheathing

(1) Except as provided in Section 9.26., continuous lumber or panel-type roof sheathing shall be installed to support the roofing.

9.23.15.2. Material Standards

(1) Wood-based panels used for roof sheathing shall conform to the requirements of,
(a) CSA O121, “Douglas Fir Plywood”,
(b) CSA O151, “Canadian Softwood Plywood”,
(c) CSA O153-M, “Poplar Plywood”,
(d) CAN/CSA-O325.0, “Construction Sheathing”, or
(e) CSA O437.0, “OSB and Waferboard”.

9.23.15.3. Direction of Installation

(1) Plywood roof sheathing shall be installed with the surface grain at right angles to the roof framing.

(2) OSB roof sheathing conforming to CAN/CSA-O325.0, “Construction Sheathing”, or to O-1 and O-2 grades as specified in CSA O437.0, “OSB and Waferboard”, shall be installed with the direction of face orientation at right angles to the roof framing members.

9.23.15.4. Joints in Panel-Type Sheathing

(1) Panel-type sheathing board shall be applied so that joints perpendicular to the roof ridge are staggered where,
(a) the sheathing is applied with the surface grain parallel to the roof ridge, and
(b) the thickness of the sheathing is such that the edges are required to be supported.

(2) A gap of not less than 2 mm shall be left between sheets of plywood, OSB or waferboard.

9.23.15.5. Lumber Roof Sheathing

(1) Lumber roof sheathing shall not be more than 286 mm wide and shall be applied so that all ends are supported with end joints staggered.

9.23.15.6. Edge Support

(1) Except as permitted in Sentence (2), where panel-type roof sheathing requires edge support, the support shall consist of,
(a) metal H clips, or
(b) not less than 38 mm by 38 mm blocking securely nailed between framing members.

(2) The supports referred to in Sentence (1) are not required when tongued-and-grooved edged panel-type sheathing board is used.

9.23.15.7. Thickness or Rating

(1) The thickness or rating of roof sheathing on a flat roof used as a walking deck shall conform to either Table 9.23.14.5.A. or Table 9.23.14.5.B. for subfloors.

(2) The thickness or rating of roof sheathing on a roof not used as a walking deck shall conform to either Table 9.23.15.7.A. or Table 9.23.15.7.B.

Table 9.23.15.7.A.
Thickness of Roof Sheathing
Forming Part of Sentence 9.23.15.7.(2)

Maximum Spacing of Supports, mm	Minimum Thickness, mm				
	Plywood and OSB, O-2 Grade		OSB, O-1 Grade and Waferboard, R-1 Grade		Lumber
	Edges Supported	Edges Unsupported	Edges Supported	Edges Unsupported	
305	7.5	7.5	9.5	9.5	17.0
406	7.5	9.5	9.5	11.1	17.0
610	9.5	12.5	11.1	12.7	19.0
Column 1	2	3	4	5	6

Table 9.23.15.7.B.
Rating for Roof Sheathing When Applying CAN/CSA-O325.0
Forming Part of Sentence 9.23.15.7.(2)

Maximum Spacing of Supports, mm	Panel Mark	
	Edges Supported	Edges Unsupported
406	2R16	1R16
508	2R20	1R20
610	2R24	1R24
Column 1	2	3

(3) Asphalt-coated or asphalt-impregnated fibreboard not less than 11.1 mm thick conforming to CAN/ULC-S706, "Wood Fibre Thermal Insulation for Buildings", is permitted to be used as a roof sheathing over supports spaced not more than 406 mm o.c., provided the roofing consists of,
(a) a continuous sheet of galvanized steel not less than 0.33 mm in thickness, or
(b) a continuous sheet of aluminum not less than 0.61 mm in thickness.

(4) All edges of sheathing described in Sentence (3) shall be supported by blocking or framing.

9.23.16. Wall Sheathing

9.23.16.1. Required Sheathing

(1) Exterior walls and gable ends shall be sheathed when the *exterior cladding* requires intermediate fastening between supports or if the *exterior cladding* requires solid backing.

9.23.16.2. Thickness, Rating and Material Standards

(1) Where wall sheathing is required for the purpose of complying with this Section, it shall conform to Table 9.23.16.2.A. or Table 9.23.16.2.B.

Table 9.23.16.2.A.
Wall Sheathing Thickness and Specifications
Forming Part of Sentence 9.23.16.2.(1)

Type of Sheathing	Minimum Thickness, mm(1)		Material Standards
	With Supports 406 mm o.c.	With Supports 610 mm o.c.	
Fibreboard (insulating)	9.5	11.1	CAN/ULC-S706
Gypsum Sheathing	9.5	12.7	CAN/CSA-A82.27-M
			ASTM C1177 / C1177M
			ASTM C1396 / C1396M
Lumber	17.0	17.0	See Table 9.3.2.1.
Mineral Fibre, Rigid Board, Type 2	25	25	CAN/ULC-S702
OSB, O-2 Grade	6.0	7.5	CSA O437.0
OSB, O-1 Grade, and Waferboard, R-1 Grade	6.35	7.9	CSA O437.0
Plywood (exterior type)	6	7.5	CSA O121
			CSA O151
			CSA O153-M
Polystyrene, Types 1 and 2	38	38	CAN/ULC-S701
Polystyrene, Types 3 and 4	25	25	CAN/ULC-S701
Polyurethane and Polyisocyanurate Type 1, faced	38	38	CAN/ULC-S704
Polyurethane and Polyisocyanurate Types 2 and 3, faced	25	25	CAN/ULC-S704
Column 1	2	3	4

Notes to Table 9.23.16.2.A.:
(1) See also Sentences 9.27.5.1.(2) to (4).

Table 9.23.16.2.B.
Rating For Wall Sheathing When Applying CAN/CSA-O325.0
Forming Part of Sentence 9.23.16.2.(1)

Maximum Spacing of Supports, mm	Panel Mark
406	W16
508	W20
610	W24
Column 1	2

9.23.16.3. Attachment of Cladding to Sheathing

(1) Gypsum sheathing, rigid insulation and fibreboard shall not be used for the attachment of siding materials.

(2) Nails used in attaching the materials listed in Sentence (1) shall be not less than 3.2 mm diam with a minimum head diameter of 11 mm.

9.23.16.4. Lumber Sheathing

(1) Lumber wall sheathing shall be applied so that all ends are supported.

(2) Where lumber wall sheathing is required to provide bracing according to Article 9.23.10.2., it shall be applied with end joints staggered.

9.23.16.5. Joints in Panel-Type Sheathing

(1) A gap of not less than 2 mm shall be left between sheets of plywood, OSB, waferboard or fibreboard.

9.23.16.6. Mansard Style Roofs

(1) Where the bottom portions of mansard style roofs are vented, the vertical framing members behind the sloping portions shall be considered on the same basis as exterior wall studs and shall conform to the appropriate requirements in Articles 9.27.3.2. to 9.27.3.6.

Section 9.24. Sheet Steel Stud Wall Framing

9.24.1. General

9.24.1.1. Application

(1) This Section applies to sheet steel studs for use in non-*loadbearing* exterior and interior walls.

(2) Where *loadbearing* steel studs are used, they shall be designed in conformance with Part 4.

9.24.1.2. Material Standards

(1) Steel studs and runners shall conform to AISI S201, "North American Standard for Cold Formed Steel Framing – Product Data".

9.24.1.3. Metal Thickness

(1) Metal thickness specified in this Section shall be the minimum base steel thickness exclusive of coatings.

9.24.1.4. Screws

(1) Screws for the application of cladding, sheathing or interior finish materials to steel studs, runners and furring channels shall conform to,
(a) ASTM C954, "Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness", or
(b) ASTM C1002, "Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs".

9.24.1.5. Cladding, Sheathing and Interior Finish Required

(1) Cladding or sheathing, and interior finish shall be installed on steel stud framing and shall be fastened with screws,
(a) spaced at the appropriate spacing described in Section 9.29., and
(b) penetrating not less than 10 mm through the metal.

9.24.2. Size of Framing

9.24.2.1. Size and Spacing of Studs in Interior Walls

(1) Except as required in Articles 9.24.2.3. and 9.24.2.4., the size and spacing of steel studs for non-*loadbearing* interior walls shall conform to Table 9.24.2.1.

Table 9.24.2.1.
Steel Studs for Non-Loadbearing Interior Walls[1]
Forming Part of Sentence 9.24.2.1.(1)

Minimum Stud Size, mm	Maximum Stud Spacing, mm	Maximum Wall Height, m
32 × 41	406	3.0
	610	2.7
32 × 64	305	4.4
	406	4.0
	610	3.5
32 × 89	305	5.2
	406	4.6
	610	3.9
32 x 152	305	6.6
	406	5.8
	610	4.9
Column 1	2	3

Notes to Table 9.24.2.1.:
(1) The values in the Table are based on a single layer of 12.7 mm gypsum panel sheathing installed on each side of the studs. Where one side is not accessible, gypsum panels on only one side will suffice. The values are also based on attaching gypsum panel sheathing using screws not smaller than No. 6 spaced at a maximum of 300 mm at edges and at intermediate supports.

9.24.2.2. Thickness of Studs

(1) Except as required in Article 9.24.2.4., steel studs in non-*loadbearing* interior walls shall have a metal thickness of not less than 0.46 mm.

9.24.2.3. Runners

(1) Runners for interior and exterior non-*loadbearing* walls shall have a thickness of not less than the thickness of the corresponding studs and shall have not less than 30 mm flanges.

9.24.2.4. Openings in Fire Separations

(1) Where openings for doors in non-*loadbearing fire separations* required to have a *fire-resistance rating* do not exceed 1.2 m in width,
(a) the width of steel studs shall be not less than 63 mm, and
(b) the steel thickness shall be not less than 0.46 mm.

(2) Where openings described in Sentence (1) exceed 1.2 m in width,
(a) the width of steel studs shall be not less than 91 mm, and
(b) the metal thickness shall be not less than 0.85 mm.

(3) The distance to the first stud beyond the jamb of any door opening in a *fire separation* required to have a *fire-resistance rating* shall not exceed 400 mm.

(4) Where the distance between the framing over the opening referred to in Sentence (3) and the top runner exceeds 400 mm in such walls, intermediate support shall be installed at intervals of not more than 400 mm above the opening.

9.24.2.5. Size and Spacing of Studs in Exterior Walls

(1) The size and spacing of non-*loadbearing* steel studs for exterior walls shall conform to Table 9.24.2.5.

Table 9.24.2.5.
Size and Spacing of Steel Studs for Non-Loadbearing Exterior Walls
Forming Part of Sentence 9.24.2.5.(1)

Minimum Stud Size, mm	Minimum Metal Thickness, mm	Maximum Stud Length, m		
		Spacing of Studs		
		305 mm (o.c.)	406 mm (o.c.)	610 mm (o.c.)
30 × 91	0.53	3.0	2.4	—
30 × 91	0.69	3.3	2.7	2.4
30 × 91	0.85	3.6	3.0	2.7
30 × 91	1.0	4.0	3.3	3.0
Column 1	2	3	4	5

9.24.3. Installation

9.24.3.1. Installation of Runners

(1) Runners shall be provided at the tops and bottoms of walls.

(2) Runners required in Sentence (1) shall be securely attached to the *building* at approximately 50 mm from the ends, and at intervals of not more than 610 mm o.c. for interior walls and 305 mm o.c. for exterior walls.

(3) Fasteners used for attachment described in Sentence (2) shall consist of the equivalent of 63 mm nails or 25 mm screws.

(4) Studs at openings and that are not full wall height shall be supported by a runner at the ends of the studs, securely fastened to the full length studs at the sides of the opening.

9.24.3.2. Fire-Rated Walls

(1) Steel studs used in walls required to have a *fire-resistance rating* shall be installed so that there is not less than a 12 mm clearance between the top of the stud and the top of the runner to allow for expansion in the event of fire.

(2) Except as provided in Article 9.24.3.6., studs in walls referred to in Sentence (1) shall not be attached to the runners in a manner that will prevent such expansion.

(3) Framing above doors with steel door frames in non-*loadbearing fire separations* required to have a *fire-resistance rating* shall consist of two runners on the flat fastened back to back. (See Appendix A.)

(4) The lower runner required in Sentence (3) shall be cut through the flanges and be bent at each end to extend upwards at least 150 mm and fastened to the adjacent studs.

9.24.3.3. Orientation of Studs

(1) Steel studs shall be installed with webs at right angles to the wall face and, except at openings, shall be continuous for the full wall height.

9.24.3.4. Support for Cladding Materials

(1) Corners and intersections of walls shall be constructed to provide support for the cladding materials.

9.24.3.5. Framing Around Openings

(1) Studs shall be doubled on each side of every opening where such openings involve more than one stud space, and shall be tripled where the openings in exterior walls exceed 2.4 m in width.

(2) Studs described in Sentence (1) shall be fastened together by screws, crimping or welding to act as a single structural unit in resisting transverse loads.

9.24.3.6. Attachment of Studs to Runners

(1) Studs shall be attached to runners by screws, crimping or welding around wall openings, and elsewhere where necessary to keep the studs in alignment during construction.

(2) Where clearance for expansion is required in Article 9.24.3.2., attachment required in Sentence (1) shall be applied between studs and bottom runners only.

Section 9.25. Heat Transfer, Air Leakage and Condensation Control

9.25.1. General

9.25.1.1. Scope and Application

(1) This Section applies to heat, air and water vapour transfer and measures to control condensation.

(2) All walls, ceilings and floors separating *conditioned space* from unconditioned space, the exterior air or the ground shall be,
(a) provided with,
  (i) thermal insulation conforming to Subsection 9.25.2.,
  (ii) an *air barrier system* conforming to Subsection 9.25.3., and
  (iii) a *vapour barrier* conforming to Subsection 9.25.4., and
(b) constructed in such a way that the properties and relative position of all materials conform to Subsection 9.25.5.

(3) Insulation and sealing of heating and ventilating ducts shall conform to Sections 9.32. and 9.33.

9.25.2. Thermal Insulation

9.25.2.1. Required Insulation

(1) All walls, ceilings and floors separating heated space from unheated space, the exterior air or the exterior *soil* shall be provided with thermal insulation in conformance with Section 12.2. to prevent moisture condensation on their room side during the winter and to ensure comfortable conditions for the occupants.

9.25.2.2. Insulation Materials

(1) Except as required in Sentence (2), thermal insulation shall conform to the requirements of,
(a) CAN/CGSB-51.25-M, "Thermal Insulation, Phenolic, Faced",
(b) CGSB 51-GP-27M, "Thermal Insulation, Polystyrene, Loose Fill",
(c) CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering",
(d) CAN/ULC-S702 "Mineral Fibre Thermal Insulation for Buildings",
(e) CAN/ULC-S703, "Cellulose Fibre Insulation (CFI) for Buildings",
(f) CAN/ULC-S704, "Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced",
(g) CAN/ULC-S705.1, "Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material – Specification", or
(h) CAN/ULC-S706, "Wood Fibre Thermal Insulation for Buildings".

(2) The *flame-spread rating* requirements contained in the standards listed in Sentence (1) shall not apply. (See Appendix A.)

(3) Insulation in contact with the ground shall be inert to the action of *soil* and water and be such that its insulative properties are not significantly reduced by moisture.

(4) Type 1 expanded polystyrene insulation as described in CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering", shall not be used as roof insulation applied above the roofing membrane.

9.25.2.3. Installation of Thermal Insulation

(1) Insulation shall be installed so that there is a reasonably uniform insulating value over the entire face of the insulated area.

(2) Insulation shall be applied to the full width and length of the space between furring or framing.

(3) Except where the insulation provides the principal resistance to air leakage, thermal insulation shall be installed so that at least one face is in full and continuous contact with an element with low air permeance. (See Appendix A.)

(4) Insulation on the interior of *foundation* walls enclosing a crawl space shall be applied so that there is not less than a 50 mm clearance above the crawl space floor if the insulation is of a type that may be damaged by water.

(5) Insulation around concrete slabs-on-ground shall be located so that heat from the *building* is not restricted from reaching the ground beneath the perimeter, where exterior walls are not supported by footings extending below frost level.

(6) Where insulation is exposed to the weather and subject to mechanical damage, it shall be protected with not less than,
(a) 6 mm asbestos-cement board,
(b) 6 mm preservative-treated plywood, or
(c) 12 mm cement parging on wire lath applied to the exposed face and edge.

(7) Except as permitted in Sentence (8), insulation and *vapour barrier* shall be protected from mechanical damage by a covering such as gypsum board, plywood, particleboard, OSB, waferboard or hardboard.

(8) In unfinished *basements*, the protection required in Sentence (7) need not be provided for mineral fibre insulation, provided it is covered with polyethylene *vapour barrier* of at least 0.15 mm in thickness.

(9) Insulation in factory-built *buildings* shall be installed so that it will not become dislodged during transportation.

9.25.2.4. Installation of Loose-Fill Insulation

(1) Except as provided in Sentences (2) to (6), loose-fill insulation shall be used on horizontal surfaces only.

(2) Where loose-fill insulation is installed in an unconfined sloped space, such as an attic space over a sloped ceiling, the supporting slope shall not be more than,
(a) 4.5 in 12 for mineral fibre or cellulose fibre insulation, and
(b) 2.5 in 12 for other types of insulation.

(3) Loose-fill insulation may be used in wood frame walls of existing *buildings*. (See Appendix A.)

(4) Where blown-in insulation is installed in above-ground or below-ground wood frame walls of new *buildings*,
(a) the density of the installed insulation shall be sufficient to preclude settlement,
(b) the insulation shall be installed behind a membrane that will permit visual inspection prior to installation of the interior finish,
(c) the insulation shall be installed in a manner that will not interfere with the installation of the interior finish, and
(d) no water shall be added to the insulation, unless it can be shown that the added water will not adversely affect other materials in the assembly.

(5) Water repellent loose-fill insulation may be used between the outer and inner wythes of masonry *cavity walls*. (See Appendix A.)

(6) Where soffit venting is used, measures shall be taken,
(a) to prevent loose-fill insulation from blocking the soffit vents and to maintain an open path for circulation of air from the vents into the *attic or roof space*, and
(b) to minimize air flow into the loose-fill insulation near the soffit vents to maintain the thermal performance of the material.

9.25.2.5. Installation of Spray-Applied Polyurethane

(1) Spray-applied polyurethane insulation shall be installed in accordance with CAN/ULC-S705.2, "Thermal Insulation – Spray-Applied Rigid Polyurethane Foam, Medium Density – Application".

9.25.3. Air Barrier Systems

9.25.3.1. Required Barrier to Air Leakage

(1) Wall, ceiling and floor assemblies that separate *conditioned spaces* from unconditioned spaces or from the ground shall be constructed so as to include an *air barrier system* that will provide a continuous barrier to air leakage,
(a) from the interior of the *building* into wall, floor, *attic or roof spaces* sufficient to prevent excessive moisture condensation in such spaces during the heating season, and
(b) from the exterior inward sufficient to prevent moisture condensation on the room side during the heating season.
(See Appendix A.)

(2) The continuity of the *air barrier system* shall extend throughout the *basement*.

9.25.3.2. Air Barrier System Properties

(1) Sheet and panel type materials intended to provide the principal resistance to air leakage shall have an air leakage characteristic not greater than 0.02 $L/(s \cdot m^2)$ measured at an air pressure differential of 75 Pa.

(2) Where polyethylene sheet is used to provide the air-tightness in the *air barrier system*, it shall conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction".

9.25.3.3. Continuity of the Air Barrier System

(1) Where the *air barrier system* consists of an air-impermeable panel-type material, all joints shall be sealed to minimize air leakage.

(2) Where the *air barrier system* consists of flexible sheet material, all joints shall be,
(a) sealed with compatible material such as tape or flexible sealant, or
(b) except as required by Sentence (3), lapped not less than 100 mm and clamped, such as between framing members, furring or blocking and rigid panels.

(3) Where an *air barrier system* consisting of flexible sheet material is installed at locations where it is not supported by an interior finish, such as a behind a bath tub, shower enclosure or fireplace, the continuity of the air barrier shall be maintained by sealing its joints.

(4) Where an interior wall meets an exterior wall, ceiling, floor or roof required to be provided with an air barrier protection, the *air barrier system* shall extend across the intersection and shall be sealed in accordance with Sentences (1) and (2).

(5) Where an interior wall projects through a ceiling or extends to become an exterior wall, spaces in the wall shall be blocked to provide continuity across those spaces with the *air barrier system* in the abutting walls or ceiling by,
(a) sealing each air barrier to the blocking, or
(b) wrapping each air barrier around the transition and sealing in accordance with Sentences (1) and (2).

(6) Where an interior floor projects through an exterior wall or extends to become an exterior floor, continuity of the *air barrier system* shall be maintained from the abutting walls across the floor assembly.

(7) Where an interior floor projects through an exterior wall to become an exterior floor,
(a) the air barrier of the wall under the floor shall be continuous with or sealed to the subfloor or the air barrier on the underside of the floor,
(b) the air barrier of the wall above the floor shall be continuous with or sealed to the subfloor or the air barrier on the top of the floor, and
(c) the spaces between floor joists shall be blocked and sealed.

(8) Where a header wrap is used as an air barrier, it shall be sealed or lapped to the wall air barrier above and below in accordance with Sentences (1) and (2).

(9) Penetrations of the *air barrier system*, such as those created by the installation of electrical wiring, electrical boxes, piping or ductwork, shall be sealed with compatible material such as tape or caulking to maintain the integrity of the *air barrier system* over the entire surface.

(10) Penetrations of the *air barrier system*, such as those created by the installation of doors, windows and other fenestration shall be sealed to maintain the integrity of the *air barrier system* over the entire surface.

(11) Where an interior air barrier is penetrated by doors, windows and other fenestration, the air barrier shall be sealed to the door frame or window frame with,
(a) compatible tape, or
(b) spray foam insulation.

(12) Where an exterior air barrier is penetrated by doors, windows and other fenestration, the air barrier shall be sealed to the door frame or window frame with,
(a) compatible flexible flashing material,
(b) caulking, or
(c) spray foam insulation.

(13) An access hatch installed through an assembly constructed with an *air barrier system* shall be weatherstripped around the perimeter to minimize air leakage.

(14) Clearances between *chimneys* or *gas vents* and the surrounding construction that would permit air leakage from within the *building* into a wall or *attic or roof space* shall be sealed by *noncombustible* material to prevent such leakage and shall be sealed to the air barrier with tape or another compatible material, and to the vent with high temperature caulking in accordance with the manufacturer's installation instructions.

(15) Where the *foundation* wall and floor slab are used as an air barrier, they shall be caulked at all joints, intersections and penetrations. (See Appendix A.)

(16) Sump pit covers shall be sealed to maintain continuity of the *air barrier system*.

9.25.3.4. Vapour Barriers Used as Air Barriers

(1) A *vapour barrier* used as an air barrier shall comply with the requirements of this Subsection.

9.25.4. Vapour Barriers

9.25.4.1. Required Barrier to Vapour Diffusion

(1) Thermally insulated wall, ceiling and floor assemblies shall be constructed with a *vapour barrier* sufficient to prevent condensation in the wall spaces, floor spaces or *attic or roof spaces*.

9.25.4.2. Vapour Barrier Materials

(1) *Vapour barriers* shall have a permeance not greater than 60 ng/(Pa·s·m^2), measured in accordance with ASTM E96 / E96M, "Water Vapor Transmission of Materials", using the desiccant method (dry cup).

(2) Where the intended use of the interior space will result in high moisture generation, the assembly shall be designed according to Part 5. (See Appendix A.)

(3) Where polyethylene is installed to serve as the *vapour barrier*, it shall conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction".

(4) Membrane-type *vapour barriers* other than polyethylene shall conform to CAN/CGSB-51.33-M, "Vapour Barrier, Sheet, Excluding Polyethylene, for Use in Building Construction".

(5) Where a coating is applied to gypsum board to function as the *vapour barrier*, the permeance of the coating shall be determined in accordance with CAN/CGSB-1.501-M, "Method for Permeance of Coated Wallboard".

(6) Where insulation functions as the *vapour barrier*, it shall be sufficiently thick so as to meet the requirement of Sentence (1).

9.25.4.3. Installation of Vapour Barriers

(1) Products installed to function as the *vapour barrier* shall protect the warm side of wall, ceiling and floor assemblies.

(2) Where different products are used for the *vapour barrier* and the insulation, the *vapour barrier* shall be installed sufficiently close to the warm side of the insulation to prevent condensation at design conditions. (See Appendix A and Appendix Note A-9.25.5.1.(1))

(3) Where the same product is used for the *vapour barrier* and the insulation, the product shall be installed sufficiently close to the warm side of the assembly to prevent condensation at design conditions. (See Appendix Notes A-9.25.4.3.(2), A-9.25.5.1.(1) and A-9.25.5.2.)

9.25.5. Properties and Position of Materials in Building Envelope

9.25.5.1. General (See Appendix A.)

(1) Sheet and panel-type materials incorporated into assemblies described in Article 9.25.1.1. shall conform to Article 9.25.5.2. where,

(a) the material has,

  (i) an air leakage characteristic less than 0.1 L/(s·m²) at 75 Pa, and

  (ii) a water vapour permeance less than 60 ng/(Pa·s·m²) when measured in accordance with ASTM E96 / E96M, "Water Vapor Transmission of Materials", using the desiccant method (dry cup), and

(b) the intended use of the interior space where the materials are installed will not result in high moisture generation.

(See Appendix A.)

(2) Where the intended use of the interior space will result in high moisture generation, the assembly shall be designed according to Part 5.

(3) Wood-based sheathing materials not more than 12.5 mm thick and complying with Article 9.23.16.2. need not comply with Sentence (1).

9.25.5.2. Position of Low Permeance Materials (See Appendix A.)

(1) Sheet and panel-type materials described in Article 9.25.5.1. shall be installed,

(a) on the warm face of the assembly,

(b) at a location where the ratio between the total thermal resistance of all materials outboard of its innermost impermeable surface and the total thermal resistance of all materials inboard of that surface is not less than that required by Table 9.25.5.2., or

(c) outboard of an air space that is vented to the outdoors.

(2) For walls, the air space described in Clause (1)(c) shall be drained and ventilated and shall be not less than 10 mm deep behind the cladding, over the full height and width of the wall.

Table 9.25.5.2.
Ratio of Outboard to Inboard Thermal Resistance
Forming Part of Sentence 9.25.5.2.(1)

Heading Degree Days of Building Location[1], Celsius Degree-Days	Minimum Ratio, Total Thermal Resistance Outboard of Material's Inner Surface to Total Thermal Resistance Inboard of Material's Inner Surface
Up to 4 999	0.20
5 000 to 5 999	0.30
6 000 to 6 999	0.35
7 000 to 7 999	0.40
Column 1	2

Notes to Table 9.25.5.2.:
(1) See MMAH Supplementary Standard SB-1, "Climatic and Seismic Data".

Section 9.26. Roofing

9.26.1. General

9.26.1.1. Purpose of Roofing

(1) Roofs shall be protected with roofing, including flashing, installed to shed rain effectively and prevent water from entering the roof as a result of ice damming.

(2) For the purpose of Sentence (1), roofs shall include platforms that effectively serve as roofs with respect to accumulation or drainage of precipitation. (See Appendix A.)

9.26.1.2. Alternate Installation Methods

(1) Methods described in CAN3-A123.51-M, "Asphalt Shingle Application on Roof Slopes 1:3 and Steeper", or CAN3-A123.52-M, "Asphalt Shingle Application on Roof Slopes 1:6 to Less than 1:3", are permitted to be used for asphalt shingle applications not described in this Section.

9.26.1.3. Solar Collector Systems

(1) A solar collector system is permitted to be installed above roofing materials conforming to Sentence 9.26.2.1.(1).

9.26.2. Roofing Materials

9.26.2.1. Material Standards

(1) Roofing materials shall conform to,
(a) CAN/CGSB-37.4-M, "Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing",
(b) CAN/CGSB-37.5-M, "Cutback Asphalt Plastic, Cement",
(c) CAN/CGSB-37.8-M, "Asphalt, Cutback, Filled, for Roof Coating",
(d) CGSB 37-GP-9Ma, "Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing",
(e) CGSB 37-GP-21M, "Tar, Cutback, Fibrated, for Roof Coating",
(f) CAN/CGSB-37.50-M, "Hot Applied, Rubberized Asphalt for Roofing and Waterproofing",
(g) CGSB 37-GP-52M, "Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric",

(h) CAN/CGSB-37.54, "Polyvinyl Chloride Roofing and Waterproofing Membrane",
(i) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing",
(j) CGSB 41-GP-6M, "Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced",
(k) CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type",
(l) CSA A123.1 / A123.5, "Asphalt Shingles Made from Organic Felt and Surfaced with Mineral Granules / Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules",
(m) CAN/CSA-A123.2, "Asphalt Coated Roofing Sheets",
(n) CSA A123.3, "Asphalt Saturated Organic Roofing Felt",
(o) CAN/CSA-A123.4, "Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems",
(p) CSA A123.17, "Asphalt Glass Felt Used in Roofing and Waterproofing",
(q) CAN/CSA-A220.0-M, "Performance of Concrete Roof Tiles",
(r) CSA O118.1, "Western Red Cedar Shakes and Shingles", or
(s) CSA O118.2-M, "Eastern White Cedar Shingles".

9.26.2.2. Nails

(1) Nails used for roofing shall be corrosion-resistant roofing or shingle nails conforming to,
(a) ASTM F1667, "Driven Fasteners: Nails, Spikes and Staples", or
(b) CSA B111, "Wire Nails, Spikes and Staples".

(2) Nails shall have sufficient length to penetrate through or 12 mm into roof sheathing.

(3) Nails used with asphalt roofing shall have a head diameter of not less than 9.5 mm and a shank thickness of not less than 2.95 mm.

(4) Nails used with wood shingles or shakes shall have a head diameter of not less than 4.8 mm and a shank thickness of not less than 2.0 mm and shall be stainless steel, aluminum or hot-dipped galvanized. (See Appendix A.)

9.26.2.3. Staples

(1) Staples used to apply asphalt or wood shingles shall be corrosion-resistant and shall be driven with the crown parallel to the eaves.

(2) Staples used with asphalt shingles shall be not less than 19 mm long, 1.6 mm diam or thickness, with not less than a 25 mm crown, except that an 11 mm crown may be used as provided in Sentence 9.26.7.4.(2).

(3) Staples used with wood shingles shall be not less than 29 mm long, 1.6 mm diam or thickness, with not less than a 9.5 mm crown and shall be stainless steel or aluminum.

9.26.3. Slope of Roof Surfaces

9.26.3.1. Slope

(1) Except as provided in Sentences (2) and (3), the slopes on which roof coverings may be applied shall conform to Table 9.26.3.1.

(2) Asphalt and gravel or coal tar and gravel roofs may be constructed with lower slopes than required in Sentence (1) when effective drainage is provided by roof drains located at the lowest points on the roofs.

(3) Profiled metal roof cladding systems specifically designed for low-slope applications are permitted to be installed with lower slopes than required in Sentence (1), provided they are installed in conformance with the manufacturer's written recommendations.

(4) Except where back-slope will not adversely affect adjacent supported or supporting elements due to water ingress, roofs and elements that effectively serve as roofs shall be constructed with sufficient slope away from,
(a) exterior walls, and
(b) *guards* that are connected to the roof, or to an element that effectively serves as a roof, by more than pickets or posts.

(5) The slope required in Sentence (4) shall be sufficient to maintain a positive slope,
(a) after expected shrinkage of the *building* frame, where these surfaces are supported by exterior walls and on exterior columns, and
(b) once design loading is taken into consideration, where these surfaces are cantilevered from exterior walls.

Table 9.26.3.1.
Roofing Types and Slope Limits
Forming Part of Sentence 9.26.3.1.(1)

Type of Roofing	Minimum Slope	Maximum Slope
Asbestos-Cement Corrugated Sheets	1 in 4	no limit
Asphalt Shingles		
Low slope application	1 in 6	no limit
Normal application	1 in 3	no limit
Built-up Roofing		
Asphalt base (without gravel)	1 in 25	1 in 2
Asphalt base (gravelled)	1 in 50[(1)]	1 in 4
Coal-tar base (gravelled)	1 in 50[(1)]	1 in 25
Cold process	1 in 25	1 in 1.33
Cedar Shakes	1 in 3	no limit
Clay Tile	1 in 2	no limit
Glass Fibre Reinforced Polyester Roofing Panels	1 in 4	no limit
Modified Bituminous Membranes	1 in 50	1 in 4
Profiled Metal Roofing	1 in 4[(2)]	no limit
Roll Roofing		
480 mm wide selvage asphalt roofing	1 in 6	no limit
Cold application felt	1 in 50	1 in 1.33
Smooth and mineral surfaced	1 in 4	no limit
Sheet Metal Shingles	1 in 4[(2)]	no limit
Slate Shingles	1 in 2	no limit
Wood Shingles	1 in 4	no limit
Column 1	2	3

Notes to Table 9.26.3.1.:
(1) See Sentence 9.26.3.1.(2).
(2) See Sentence 9.26.3.1.(3).

9.26.4. Flashing at Intersections

9.26.4.1. Required Flashing at Intersections (See Appendix A.)

(1) Except where the omission will not adversely affect adjacent supported or supporting elements, flashing shall be installed at junctions between roofs and,
(a) walls that rise above the roof, and
(b) *guards* that are connected to the roof by other than pickets or posts.

(2) For the purpose of Sentence (1), roofs shall include platforms that effectively serve as roofs with respect to accumulation or drainage of precipitation.

9.26.4.2. Materials

(1) Sheet metal flashing shall consist of not less than,
(a) 1.73 mm thick sheet lead,
(b) 0.33 mm thick galvanized steel,
(c) 0.33 mm thick copper,
(d) 0.35 mm thick zinc, or
(e) 0.48 mm thick aluminum.

9.26.4.3. Valley Flashing

(1) Where sloping surfaces of shingled roofs intersect to form a valley, the valley shall be flashed.

(2) Valley flashing shall be installed over continuous sheathing.

(3) Closed valleys shall not be used with rigid shingles on slopes of less than 1 in 1.2.

(4) Closed valley flashing shall consist of sheet metal, self sealing composite membranes consisting of polyethylene and bituminous material or one layer of either Type S smooth surface roll roofing or Type M mineral surface roll roofing (mineral surface down) not less than 600 mm wide, and nails shall not penetrate the flashing within 75 mm of its edge or 124 mm of the bottom of the valley centreline.

(5) Open valleys shall be flashed with,
(a) at least one layer of sheet metal not less than 600 mm wide, or
(b) no fewer than two layers of roll roofing.

(6) The bottom layer of roofing required in Sentence (4) shall consist of not less than Type S smooth roll roofing or Type M mineral surface roll roofing (mineral surface down) not less than 457 mm wide, centred in the valley and fastened with nails spaced not more than 450 mm o.c. located 25 mm away from the edges.

(7) The top layer of roofing required in Sentence (4) shall consist of not less than Type M mineral surface roll roofing (mineral surface up), 914 mm wide, centred in the valley, applied over a 100 mm wide strip of cement along each edge of the bottom layer, and fastened with a sufficient number of nails to hold it in place until the shingles are applied.

9.26.4.4. Intersection of Shingle Roofs and Masonry

(1) The intersection of shingle roofs and masonry walls or *chimneys* shall be protected with flashing.

(2) Counter flashing required in Sentence (1) shall be embedded not less than 25 mm in the masonry and shall extend not less than 150 mm down the masonry and lap the lower flashing not less than 100 mm.

(3) Flashing along the slopes of a roof described in Sentence (1) shall be stepped so that there is not less than a 75 mm head lap in both the lower flashing and counter flashing.

(4) Where the roof described in Sentence (1) slopes upwards from the masonry, the flashing shall extend up the roof slope to a point equal in height to the flashing on the masonry, but not less than 1.5 times the shingle exposure.

9.26.4.5. Intersection of Shingle Roofs and Walls Other Than Masonry

(1) The intersection of shingle roofs and walls clad with other than masonry shall be protected with flashing.

(2) Flashing required in Sentence (1) shall be installed so that it extends up the wall not less than 75 mm behind the sheathing paper, and extends not less than 75 mm horizontally.

(3) Along the slope of the roof, the flashing required in Sentence (1) shall be stepped with not less than a 75 mm head lap.

9.26.4.6. Intersection of Built-Up Roofs and Masonry

(1) The intersection of built-up roofs with masonry walls or *chimneys* shall have a cant strip at the intersection and a roofing membrane shall be mopped over the cant strip and not less than 150 mm up the wall.

(2) Counter flashing installed over the intersection referred to in Sentence (1) shall be embedded not less than 25 mm in the masonry, and shall be of sufficient length to extend down not less than 150 mm, lapping the membrane on the masonry not less than 100 mm.

9.26.4.7. Intersection of Built-Up Roofs and Walls Other Than Masonry

(1) The intersection of built-up roofs with walls clad with other than masonry shall have a cant strip at the intersection.

(2) The roofing membrane shall be mopped over the cant strip referred to in Sentence (1).

(3) Flashing plies shall extend not less than 150 mm up the wall referred to in Sentence (1) behind the sheathing paper.

9.26.4.8. Chimney Saddles

(1) Except as otherwise permitted in Sentence (5), *chimney* saddles shall be installed where the upper side of a *chimney* on a sloping roof is more than 750 mm wide.

(2) *Chimney* saddles shall be covered with sheet metal or roofing material of weight and quality equivalent to the roofing.

(3) Saddles shall be flashed where they intersect the roof.

(4) The intersection of the saddle and the *chimney* shall be flashed and counterflashed as required in Article 9.26.4.4.

(5) A *chimney* saddle need not be installed if the intersection between the *chimney* and roof is protected by sheet metal flashing that extends up the *chimney* to a height equal to at least one-sixth the width of the *chimney*, but not less than 150 mm, and up the roof slope to a point equal in height to the flashing on the *chimney*, but not less than 1.5 times the shingle exposure.

(6) Flashing described in Sentence (5) at the *chimney* shall be counterflashed as required by Article 9.26.4.4.

9.26.5. Eave Protection for Shingles and Shakes

9.26.5.1. Required Eave Protection

(1) Except as provided in Sentence (2), eave protection shall be provided on shingle, shake or tile roofs, extending from the edge of the roof a minimum of 900 mm up the roof slope to a line not less than 300 mm inside the inner face of the exterior wall.

(2) Eave protection is not required,
(a) over unheated garages, carports and porches,
(b) where the roof overhang exceeds 900 mm measured along the roof slope from the edge of the roof to the inner face of the exterior wall,
(c) on roofs of asphalt shingles installed in accordance with Subsection 9.26.8.,
(d) on roofs with slopes of 1 in 1.5 or greater, or
(e) in regions with 3 500 or fewer degree-days.

9.26.5.2. Materials

(1) Eave protection shall be laid beneath the starter strip and shall consist of,
(a) No. 15 asphalt-saturated felt laid in two plies lapped 480 mm and cemented together with lap cement,
(b) Type M or S roll roofing laid with not less than 100 mm head and end laps cemented together with lap cement,
(c) glass fibre or polyester fibre coated base sheets, or
(d) self-sealing composite membranes consisting of modified bituminous coated material.

9.26.6. Underlay Beneath Shingles

9.26.6.1. Materials

(1) Except as required in Sentence (2), when underlay is used beneath shingles, it shall be,
(a) asphalt-saturated sheathing paper weighing not less than 0.195 kg/m^2, or
(b) No. 15 plain or perforated asphalt-saturated felt.
(See Appendix A.)

(2) Underlay used beneath wood shingles shall be breather type.

9.26.6.2. Installation

(1) When used with shingles, underlay shall be installed parallel to the eaves with head and end lap of not less than 50 mm.

(2) The top edge of each strip referred to in Sentence (1) shall be fastened with sufficient roofing nails to hold it in place until the shingles are applied.

(3) The underlay referred to in Sentence (1) shall overlap the eave protection by not less than 100 mm.

9.26.7. Asphalt Shingles on Slopes of 1 in 3 or Greater

9.26.7.1. Coverage

(1) Coverage shall be not less than two thicknesses of shingle over the entire roof, disregarding cutouts.

9.26.7.2. Starter Strip

(1) A starter strip shall be installed along the lower edge of the roof so that it extends approximately 12 mm beyond the eaves and rake of the roof and fastened along the bottom edge with nails spaced not more than 300 mm o.c.

(2) Starter strips shall be,
(a) at least Type M mineral-surfaced roll roofing not less than 300 mm wide,
(b) shingles of the same weight and quality as those used as a roof covering with tabs facing up the roof slope, or
(c) pre-manufactured starter strips installed with sealant at the eaves.

(3) Starter strips need not be provided where eave protection of not less than Type M mineral-surfaced roll roofing is provided or self-sealing composite membranes consisting of polyethylene and bituminous material is provided.

9.26.7.3. Head Lap

(1) Shingles shall have a head lap of not less than 50 mm.

9.26.7.4. Fasteners

(1) Except as provided in Sentence (2), shingles shall be fastened with at least four nails or staples for 1 000 mm wide shingles so that no nails or staples are exposed.

(2) Where staples with an 11 mm crown are used, shingles shall be fastened with at least six staples.

(3) Fasteners may be reduced for narrower shingles in proportion to the width of the shingle or when shingles incorporating interlocking devices are used.

(4) Fasteners referred to in Sentences (1) and (2) shall be located 25 mm to 40 mm from each end of each strip shingle with other fasteners equally spaced between them.

(5) Fasteners referred to in Sentences (1) and (2) shall be located not less than 12 mm above the tops of the cutouts.

9.26.7.5. Securing of Tabs

(1) Shingle tabs shall be secured by a spot of plastic cement not exceeding 25 mm diam under the centre of each tab or by interlocking devices or self-sealing strips.

9.26.7.6. Hips and Ridges

(1) Shingles on hips and ridges shall be applied so they extend not less than 100 mm on either side of the hip or ridge, and shall be lapped not less than 150 mm.

(2) Shingles referred to in Sentence (1) shall be fastened with nails or staples on each side located not more than 25 mm from the edge and 25 mm above the butt of the overlying shingle.

9.26.7.7. Eave Protection

(1) Eave protection shall conform to Subsection 9.26.5.

9.26.7.8. Flashing

(1) Flashing shall conform to Subsection 9.26.4.

9.26.8. Asphalt Shingles on Slopes of Less Than 1 in 3

9.26.8.1. Coverage

(1) Except for the first two courses, coverage shall be not less than three thicknesses of shingle over the entire roof, disregarding cutouts.

9.26.8.2. Starter Strip

(1) A starter strip shall be installed as in Article 9.26.7.2.

(2) Starter strips required in Sentence (1) shall be laid in a continuous band of cement not less than 200 mm wide.

9.26.8.3. Securing of Tabs

(1) Shingle tabs shall be secured with cold application cement applied at the rate of not less than 0.5 L/m² of cemented area, or hot application asphalt applied at the rate of 1 kg/m² of cemented area.

9.26.8.4. Securing of Shingle Courses

(1) The first course of shingles shall be secured by a continuous band of cement along the eaves applied so that the width of the band equals the shingle exposure plus 100 mm.

(2) The succeeding courses of shingles shall be secured by a continuous band of cement applied so that the width of the band equals the shingle exposure plus 50 mm.

(3) The band required in Sentence (2) shall be located not more than 50 mm above the butt of the overlying course of shingles.

9.26.8.5. Hips and Ridges

(1) Shingles on hips and ridges shall be not less than 300 mm wide applied to provide triple coverage.

(2) Shingles referred to in Sentence (1) shall be cemented to the roof shingles and to each other with a coat of cement and fastened with nails or staples located 40 mm above the butt of the overlying shingle and 50 mm from each edge.

9.26.8.6. Flashing

(1) Flashing shall conform to Subsection 9.26.4.

9.26.8.7. Fastening

(1) Shingles shall be fastened in accordance with Article 9.26.7.4.

9.26.9. Wood Roof Shingles

9.26.9.1. Decking

(1) Decking for wood shingled roofs may be continuous or spaced.

9.26.9.2. Grade

(1) Western cedar shingles shall be not less than No. 2 grade.

(2) Eastern white cedar shingles shall be not less than B (clear) grade.

9.26.9.3. Size

(1) Wood shingles shall be not less than 400 mm long and not less than 75 mm nor more than 350 mm wide.

9.26.9.4. Spacing and Joints

(1) Shingles shall be spaced approximately 6 mm apart and offset at the joints in adjacent courses not less than 40 mm so that joints in alternate courses are staggered.

9.26.9.5. Fastening

(1) Shingles shall be fastened with two nails or staples located approximately 20 mm from the sides of the shingle and 40 mm above the exposure line.

9.26.9.6. Exposure

(1) The exposure of wood roof shingles shall conform to Table 9.26.9.6.

Table 9.26.9.6.
Exposure of Wood Shingles
Forming Part of Sentence 9.26.9.6.(1)

Roof Slope	Maximum Exposure, mm					
	No. 1 or A Grade Length of Shingle, mm			No. 2 or B Grade Length of Shingle, mm		
	400	450	600	400	450	600
< 1 in 3	100	115	165	90	100	140
≥ 1 in 3	125	140	190	100	115	165
Column 1	2	3	4	5	6	7

9.26.9.7. Flashing

(1) Flashing shall conform to Subsection 9.26.4.

9.26.9.8. Eave Protection

(1) Eave protection shall conform to Subsection 9.26.5.

9.26.10. Cedar Roof Shakes

9.26.10.1. Size and Thickness

(1) Shakes shall be not less than 450 mm long and not less than 100 mm nor more than 350 mm wide with a butt thickness of not more than 32 mm and not less than 9 mm.

9.26.10.2. Underlay

(1) Where eave protection is not provided, an underlay conforming to the requirements in Article 9.26.6.1. for wood shingles shall be laid as a strip not less than 900 mm wide along the eaves.

(2) A strip of material similar to that described in Sentence (1) not less than 450 mm wide shall be interlayed between each course of shakes with the bottom edge of the strip positioned above the butt line at a distance equal to double the exposure of the shakes.

(3) Interlayed strips in Sentence (2) shall be lapped at least 150 mm at hips and ridges in a manner that will prevent water from reaching the roof sheathing.

9.26.10.3. Spacing and Joints

(1) Shakes shall be spaced 6 mm to 9 mm apart and the joints in one course shall be separated not less than 40 mm from joints in adjacent courses.

9.26.10.4. Fastening

(1) Shakes shall be fastened with nails located approximately 20 mm from the sides of the shakes and 40 mm above the exposure line.

9.26.10.5. Exposure

(1) The exposure of wood shakes shall not exceed,
(a) 190 mm for shakes not less than 450 mm long, and
(b) 240 mm for shakes not less than 600 mm long.

9.26.10.6. Flashing

(1) Flashing shall conform to Subsection 9.26.4.

9.26.10.7. Eave Protection

(1) Eave protection shall conform to Subsection 9.26.5.

9.26.10.8. Grade

(1) Shakes shall be not less than No. 1 or Handsplit grade.

9.26.11. Built-Up Roofs

9.26.11.1. Quantity of Materials

(1) The quantities of bituminous materials used on built-up roofs shall conform to Table 9.26.11.1.

Table 9.26.11.1.
Quantities of Bitumen for Built-Up Roofs
Forming Part of Sentence 9.26.11.1.(1)

Type of Roof	Amount of Bitumen per Square Metre of Roof Surface	
	Mopping Coats Between Layers	Flood Coat
Asphalt and aggregate	1 kg	3 kg
Coal-tar and aggregate	1.2 kg	3.6 kg
Cold process roofing	0.75 L cold process cement	2 L cold process top coating
Column 1	2	3

9.26.11.2. Coal-Tar and Asphalt Products

(1) Coal-tar products and asphalt products shall not be used together in built-up roof construction.

9.26.11.3. Roof Felts

(1) Bitumen roofing felts shall be not less than No.15 felt.

9.26.11.4. Aggregate Surfacing

(1) Aggregate used for surfacing built-up roofs shall be clean, dry and durable and shall consist of particles of gravel, crushed stone or air-cooled blast furnace slag having a size of from 6 mm to 15 mm.

(2) The minimum amount of aggregate surfacing per square metre of roof surface shall be 15 kg gravel or crushed stone or 10 kg crushed slag.

9.26.11.5. Flashing

(1) Flashing shall conform to Subsection 9.26.4.

9.26.11.6. Number of Layers

(1) Built-up roofing shall consist of at least three mopped-down layers of roofing felt flood coated with bitumen.

9.26.11.7. Installation of Layers

(1) In hot process applications, each layer of bitumen-saturated felt shall be laid while the bitumen is hot, with each layer overlapping the previous one.

(2) The full width under each lap referred to in Sentence (1) shall be coated with bitumen so that in no place does felt touch felt.

(3) Felt shall be laid free of wrinkles and shall be rolled directly into the hot bitumen and broomed forward and outward from the centre to ensure complete adhesion.

9.26.11.8. Roofing Over Wood-Based Sheathing

(1) Except as permitted in Sentence (2), built-up roofing applied over wood, plywood, OSB or waferboard roof sheathing shall be laid over an additional base layer of felt laid dry over the entire roof deck with at least a 50 mm headlap and a 50 mm sidelap between each sheet.

(2) Where plywood, OSB or waferboard roof sheathing is used, the dry layer of felt required in Sentence (1) may be omitted when the joints are taped and the sheathing is primed with asphalt.

9.26.11.9. Attachment to Decking

(1) Roofing shall be securely attached to the decking or where insulation is applied above the deck, the insulation shall be securely attached to the deck before the first layer of felt is fastened to the insulation.

9.26.11.10. Cant Strips

(1) Except as permitted in Sentence (4), a cant strip shall be provided at the edges of roofs.

(2) No fewer than two plies of the roofing membrane shall be carried over the top of the cant strip.

(3) Flashing shall extend over the top of the cant strip and be shaped to form a drip.

(4) The cant strip required in Sentence (1) may be omitted where a gravel stop is provided at the edge of roofs.

(5) The roofing membranes shall be carried over the edge of the roof before the gravel stop referred to in Sentence (4) is fastened and two plies of roofing membrane mopped to the top surface of the gravel stop before the flood coat is applied.

(6) The gravel stop referred to in Sentence (4) shall extend over the edge of the roof to form a drip or shall be flashed so that the flashing extends over the edge to form a drip.

9.26.12. Selvage Roofing

9.26.12.1. Double Coverage

(1) Wide selvage asphalt roofing shall provide double coverage over the entire roof surface.

9.26.12.2. Joints

(1) Plies of selvage roofing shall be cemented together to ensure a water-tight joint.

9.26.13. Sheet Metal Roofing

9.26.13.1. Thickness

(1) Sheet metal roofing shall be not less than,
(a) 0.33 mm thick galvanized steel,
(b) 0.46 mm thick copper,
(c) 0.46 mm thick zinc, or
(d) 0.48 mm thick aluminum.

9.26.13.2. Support

(1) Where sheet metal roofing is not supported by roof decking but spans between spaced supports, the panels shall be designed to support the specified *live loads* for roofs.

9.26.14. Glass Reinforced Polyester Roofing

9.26.14.1. Support

(1) Where glass reinforced polyester roofing panels are not supported by roof decking but span between spaced supports, the panels shall be designed to support the specified roof loads.

9.26.15. Hot Applied Rubberized Asphalt Roofing

9.26.15.1. Installation

(1) Hot applied rubberized asphalt roofing shall be installed in accordance with CAN/CGSB-37.51-M, "Application for Hot Applied Rubberized Asphalt for Roofing and Waterproofing".

9.26.16. Polyvinyl Chloride Sheet Roofing

9.26.16.1. Installation

(1) Polyvinyl chloride sheet applied roofing membrane shall be installed in accordance with CGSB 37-GP-55M, "Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane".

9.26.17. Concrete Roof Tiles

9.26.17.1. Installation

(1) Concrete roof tiles shall be installed according to CAN/CSA-A220.1-M, "Installation of Concrete Roof Tiles". (See Appendix A.)

9.26.18. Roof Drains and Downspouts

9.26.18.1. Roof Drains

(1) When roof drains are provided they shall conform to Part 7.

9.26.18.2. Downspouts

(1) Where downspouts are provided and are not connected to a sewer, extensions shall be provided to carry rainwater away from the *building* in a manner that will prevent *soil* erosion.

Section 9.27. Cladding

9.27.1. Application

9.27.1.1. General

(1) Where lumber, wood shingles, shakes, fibre-cement shingles, planks and sheets, plywood, OSB, waferboard, hardboard, vinyl, aluminum and steel, including trim and soffits, are installed as cladding on wood frame walls exposed to precipitation, the cladding assembly shall comply with,
(a) Subsections 9.27.2. to 9.27.12., or
(b) Part 5.

(2) Where stucco is installed as cladding on wood frame or masonry walls exposed to precipitation, the cladding assembly shall comply with,
(a) Subsections 9.27.2. to 9.27.4., and Section 9.28., or
(b) Part 5.

(3) Where masonry serves as cladding on wood frame or masonry walls exposed to precipitation, the cladding assembly shall comply with,
(a) Subsections 9.27.2. to 9.27.4., and Section 9.20., or
(b) Part 5.

(4) Where asphalt shingles are installed as cladding on wood frame walls exposed to precipitation, the cladding assembly shall comply with,
(a) Subsections 9.26.7. and 9.27.2. to 9.27.4., or
(b) Part 5.

(5) Where an exterior insulation finish system is installed as cladding on wood-frame, masonry, cold-formed steel stud or cast-in-place concrete walls exposed to precipitation, the cladding assembly shall comply with,
(a) Subsections 9.25.5., 9.27.2. to 9.27.4. and 9.27.13., or
(b) Part 5.

(6) Where cladding materials or systems other than those described in Sentences (1) to (5) are installed, or where these are installed on substrates other than those identified in Sentences (1) to (5), the cladding materials or systems and their installation shall comply with Part 5.

9.27.2. Required Protection from Precipitation (See Appendix A.)

9.27.2.1. Minimizing and Preventing Ingress and Damage

(1) Except where exterior walls are protected from precipitation or where it can be shown that ingress will not adversely affect occupant health or safety, exterior walls shall be designed and constructed to,
(a) minimize the ingress of precipitation into the assembly, and
(b) prevent ingress into interior space.
(See Appendix A.)

(2) Except where exterior walls are protected from specific mechanisms of deterioration, such as mechanical impact and ultraviolet radiation, exterior walls shall be designed and constructed to minimize the likelihood of their required performance being reduced to an unacceptable level as a result of those mechanisms.

9.27.2.2. Minimum Protection from Precipitation Ingress

(1) Exterior walls exposed to precipitation shall be protected against ingress of precipitation with an exterior cladding assembly consisting of a first plane of protection and a second plane of protection where the wall encloses spaces of *residential occupancy* or spaces that directly serve spaces of *residential occupancy*. (See Appendix A.)

9.27.2.3. First and Second Planes of Protection

(1) Where walls required to provide protection from precipitation comprise assemblies with first and second planes of protection,
(a) the first plane of protection shall,
  (i) consist of cladding, with appropriate trim, accessory pieces and fasteners, and
  (ii) be designed and constructed to minimize the passage of rain and snow into the wall by minimizing holes and managing precipitation ingress caused by kinetic energy of raindrops, surface tension, capillarity, gravity, and air pressure differences,
(b) the second plane of protection shall be designed and constructed to,
  (i) intercept all precipitation that gets past the first plane of protection, and
  (ii) effectively dissipate any precipitation to the exterior, and
(c) the protection provided by the first and second planes of protection shall be maintained at,
  (i) wall penetrations created by the installation of components and services such as windows, doors, ventilation ducts, piping, wiring and electrical outlets, and
  (ii) the interface with other wall assemblies.

9.27.2.4. Protection of Cladding from Moisture

(1) A clearance of not less than 200 mm shall be provided between finished ground and cladding that is adversely affected by moisture, such as untreated wood, plywood, OSB, waferboard and hardboard.

(2) A clearance of not less than 50 mm shall be provided between a roof surface and cladding that is adversely affected by moisture, such as untreated wood, plywood, OSB, waferboard and hardboard.

9.27.3. Second Plane of Protection

9.27.3.1. Elements of the Second Plane of Protection (See Appendix A.)

(1) The second plane of protection shall consist of a drainage plane with appropriate inner boundary and flashing to dissipate rainwater to the exterior.

(2) The inner boundary of the drainage plane shall comply with,
(a) Articles 9.27.3.2. to 9.27.3.6., or
(b) Subsection 9.27.13.

(3) The protection provided by the second plane of protection shall be maintained,
(a) at wall penetrations created by the installation of components and services such as windows, doors, ventilation ducts, piping, wiring and electrical outlets, and
(b) at the interface with other wall assemblies.

(4) Flashing material and installation shall comply with Articles 9.27.3.7. and 9.27.3.8.

9.27.3.2. Sheathing Membrane Material Standard

(1) Sheathing membranes shall conform to the performance requirements of CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type".

9.27.3.3. Required Sheathing Membrane and Installation

(1) Except as provided in Articles 9.27.3.4. to 9.27.3.6., at least one layer of sheathing membrane shall be applied beneath siding, stucco or masonry veneer.

(2) Sheathing membrane required in Sentence (1) shall be applied so that joints are lapped not less than 100 mm.

(3) Where sheathing membrane required in Sentence (1) is applied horizontally, the upper sheets shall overlap the lower sheets.

9.27.3.4. Insulating Sheathing in Lieu of Sheathing Membrane

(1) Where non-wood-based rigid exterior insulating sheathing, or exterior insulating sheathing with an integral sheathing membrane is installed, a separate sheathing membrane is not required.

(2) Where insulating sheathing is installed as provided in Sentence (1),
(a) sheathing panels subject to moisture deterioration shall be sealed at all joints, and
(b) the joints of sheathing panels not subject to moisture deterioration shall be,
  (i) sealed at all joints, or
  (ii) lapped or tongue and groove, and detailed to ensure drainage of water to the exterior.
(See Appendix A.)

9.27.3.5. Sheathing Membranes in Lieu of Sheathing

(1) Except as provided in Article 9.27.3.6., where no sheathing is used, at least two layers of sheathing membrane shall be applied beneath the cladding. (See Appendix A.)

(2) All joints in the sheathing membrane required in Sentence (1) shall occur over framing, and the membrane shall be fastened to the framing with roofing nails or staples spaced not more than 150 mm along the edges of the outer layer of sheathing paper.

(3) Wall sheathing is permitted to be used in lieu of one layer of sheathing membrane required in Sentence (1), and the thickness need not conform to Table 9.23.16.2.A.

9.27.3.6. Face Sealed Cladding (See Appendix A.)

(1) Sheathing membrane is permitted to be omitted beneath cladding when the joints in the cladding are formed to effectively prevent the passage of wind and rain in conformance with Sentence (2) or (3), as applicable.

(2) Cladding consisting of sheets of plywood, hardboard, OSB, waferboard or fibre cement is considered to meet the requirements of Sentence (1), provided the cladding is applied so that,
(a) all edges are directly supported by framing,

(b) the vertical joints between adjacent sheets are sealed and,
   (i) covered with battens,
   (ii) shiplapped, or
   (iii) otherwise matched to provide weathertight joints, and
(c) the horizontal joints between adjacent sheets are sealed and,
   (i) shiplapped, or
   (ii) otherwise matched to provide weathertight joints.

(3) Metal siding consisting of sheets of metal is considered to meet the requirements of Sentence (1) where the joints between sheets are of the locked-seam type.

9.27.3.7. Flashing Materials

(1) Flashing shall consist of not less than,
(a) 1.73 mm thick sheet lead,
(b) 0.33 mm thick galvanized steel,
(c) 0.46 mm thick copper,
(d) 0.46 mm thick zinc,
(e) 0.48 mm thick aluminum, or
(f) 1.02 mm thick vinyl.

9.27.3.8. Flashing Installation

(1) Except as provided in Sentence (2), flashing shall be installed at,
(a) every horizontal junction between claddings elements,
(b) every horizontal offset in the cladding, and
(c) every horizontal line where the cladding substrates change and where,
   (i) the substrates differ sufficiently for stresses to be concentrated along that line, or
   (ii) the installation of the cladding on the lower substrate may compromise the drainage of moisture from behind the cladding above.
(See Appendix A.)

(2) Flashing need not be installed as described in Sentence (1),
(a) where the upper cladding elements overlap the lower cladding elements by not less than 25 mm,
(b) where,
   (i) the cladding above and below the joint is installed outboard of a drained and vented air space, and
   (ii) the horizontal detail is constructed so as to minimize ingress of precipitation into the air space, or
(c) at horizontal construction joints in stucco, where,
   (i) the joint is finished with an expansion-contraction strip, and
   (ii) the cladding is installed outboard of a drained and vented air space.

(3) Flashing shall be installed over exterior wall openings where the vertical distance from the bottom of the eave to the top of the trim is more than one-quarter of the horizontal overhang of the eave. (See Appendix A.)

(4) Flashing described in Sentences (1) and (3) shall,
(a) extend not less that 50 mm upward inboard of the sheathing membrane or sheathing installed in lieu of the sheathing membrane,
(b) have a slope of not less than 6% toward the exterior after the expected shrinkage of the *building* frame,
(c) terminate at each end with an end-dam,
   (i) with a height in millimetres not less than 25 mm or 1/10 of the value of the 1 in 5 driving rain wind pressure in Pa, and
   (ii) at the height defined in Subclause (i), extending to the face of the adjacent cladding,

(d) lap not less than 10 mm vertically over the *building* element below, and
(e) terminate in a drip extending not less than 5 mm outward from the outer face of the *building* element below.
(See Appendix A.)

(5) Where the sills of windows and doors installed in exterior walls are not self-flashing, flashing shall be installed between the underside of the window or door and the wall construction below. (See Appendix A.)

9.27.4. Sealants

9.27.4.1. Required Sealants

(1) Sealant shall be provided where required to prevent the entry of water into the structure.

(2) Sealant shall be provided between masonry, siding or stucco and the adjacent door and window frames or trim, including sills unless such locations are completely protected from the entry of rain.

(3) Sealant shall be provided at vertical joints between different cladding materials unless the joint is suitably lapped or flashed to prevent the entry of rain.

9.27.4.2. Materials

(1) Sealants shall be,
(a) non-hardening types suitable for exterior use,
(b) selected for their ability to resist the effects of weathering, and
(c) compatible with, and adhere to, the substrate to which they are applied.
(See Appendix A.)

(2) Sealants shall conform to,
(a) ASTM C834, "Latex Sealants",
(b) ASTM C920, "Elastomeric Joint Sealants",
(c) ASTM C1184, "Structural Silicone Sealants", or
(d) ASTM C1311, "Solvent Release Sealants".

(3) Backer rod shall conform to ASTM C1330, "Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants".

9.27.5. Attachment of Cladding

9.27.5.1. Attachment

(1) Except as permitted in Sentences (2) to (7), cladding shall be fastened to the framing members or furring members, or to blocking between the framing members.

(2) Vertical lumber and stucco lath or reinforcing are permitted to be attached to sheathing only where the sheathing consists of not less than,
(a) 14.3 mm lumber,
(b) 12.5 mm plywood, or
(c) 12.5 mm OSB or waferboard.

(3) Vertically applied metal siding and wood shingles and shakes are permitted to be attached to the sheathing only where the sheathing consists of not less than,
(a) 14.3 mm lumber,
(b) 7.5 mm plywood, or
(c) 7.5 mm OSB or waferboard.

(4) Asbestos-cement shingles are permitted to be attached to the sheathing only when the sheathing consists of not less than,
(a) 14.3 mm lumber,
(b) 9.5 mm plywood, or
(c) 9.5 mm OSB or waferboard.

(5) Where wood shingles or shakes are applied to sheathing that is not suitable for attaching the shingles or shakes, the shingles or shakes may be attached to a wood lath not less than 38 mm by 9.5 mm thick securely nailed to the framing and applied as described in Article 9.27.7.5.

(6) Where asbestos-cement shingles are applied to sheathing that is not suitable for attaching the shingles, the shingles may be fastened to a wood lath not less than 89 mm by 9.5 mm thick securely nailed to the framing.

(7) Lath referred to in Sentence (6) shall be applied so that it overlaps the preceding shingle course by not less than 20 mm.

9.27.5.2. Blocking

(1) Blocking for the attachment of cladding shall be not less than 38 mm by 38 mm lumber securely nailed to the framing and spaced not more than 610 mm o.c.

9.27.5.3. Furring

(1) Except as permitted in Sentences 9.27.5.1.(5) and (6), furring for the attachment of cladding shall be not less than 19 mm by 38 mm lumber when applied over sheathing.

(2) When applied without sheathing, furring referred to in Sentence (1) shall be not less than,
(a) 19 mm by 64 mm lumber on supports spaced not more than 406 mm o.c., or
(b) 19 mm by 89 mm on supports spaced not more than 610 mm o.c.

(3) Furring referred to in Sentence (1) shall be,
(a) securely fastened to the framing, and
(b) spaced not more than 610 mm o.c.

9.27.5.4. Size and Spacing of Fasteners

(1) Nail or staple size and spacing for the attachment of cladding and trim shall conform to Table 9.27.5.4.

Table 9.27.5.4.
Attachment of Cladding
Forming Part of Sentence 9.27.5.4.(1)

Type of Cladding	Minimum Nail or Staple Length, mm	Minimum Number of Nails or Staples	Maximum Nail or Staple Spacing, mm (o.c.)
Wood trim	51	—	600
Lumber siding or horizontal siding made from sheet metal	51	—	600
Metal cladding	38	—	600 (nailed to framing) 400 (nailed to sheathing only)
Wood shakes			
up to 200 mm in width	51	2	—
over 200 mm in width	51	3	—
Wood shingles			
200 mm in width	32	2	—
over 200 mm in width	32	3	—
Asbestos-cement shingles	32	2	—
Panel or sheet type cladding			
up to 7 mm thick	38	—	150 (along edges) 300 (along intermediate supports)
more than 7 mm thick	51	—	
Column 1	2	3	4

9.27.5.5. Fastener Materials

(1) Nails or staples for the attachment of cladding and wood trim shall be corrosion-resistant and shall be compatible with the cladding material.

9.27.5.6. Expansion and Contraction

(1) Fasteners for metal or vinyl cladding shall be positioned to permit expansion and contraction of the cladding.

9.27.5.7. Penetration of Fasteners

(1) Fasteners for shakes and shingles shall penetrate through the nail-holding base or not less than 19 mm into the framing.

(2) Fasteners for cladding other than that described in Sentence (1) shall penetrate through the nail-holding base or not less than 25 mm into the framing.

9.27.6. Lumber Siding

9.27.6.1. Materials

(1) Lumber siding shall be sound, free of knot holes, loose knots, through checks or splits.

9.27.6.2. Thickness and Width

(1) Drop, rustic, novelty, lapped board and vertical wood siding shall be not less than 14.3 mm thick and not more than 286 mm wide.

(2) Bevel siding shall be,
(a) not less than 5 mm thick at the top, and
(b) not less than,
  (i) 12 mm thick at the butt for sidings 184 mm or less in width, and
  (ii) 14.3 mm thick at the butt for sidings wider than 184 mm.

(3) Bevel siding shall be not more than 286 mm wide.

9.27.6.3. Joints

(1) Lumber siding shall prevent water from entering at the joints by the use of lapped or matched joints or by vertical wood battens.

(2) Siding shall overlap not less than 1 mm per 16 mm width of lumber, but not less than,
(a) 9.5 mm for matched siding,
(b) 25 mm for lapped bevel siding, or
(c) 12 mm for vertical battens.

9.27.7. Wood Shingles and Shakes

9.27.7.1. Materials

(1) Shingles and shakes shall conform to,
(a) CSA O118.1, "Western Red Cedar Shakes and Shingles", or
(b) CSA O118.2-M, "Eastern White Cedar Shingles".

(2) Western cedar shakes shall be not less than No. 1 grade or Handsplit grade, and western cedar shingles not less than No. 2 grade, except that No. 3 grade may be used for undercoursing.

(3) Eastern white cedar shakes shall be at least B (clear) grade, except that C grade may be used for undercoursing.

9.27.7.2. Width

(1) Shingles and shakes shall be not less than 65 mm or more than 350 mm wide.

9.27.7.3. Fasteners

(1) Shingles or shakes shall be fastened with nails located approximately 20 mm from each edge and not less than 25 mm above the exposure line for single-course applications, or approximately 50 mm above the butt for double-course applications.

9.27.7.4. Offsetting of Joints

(1) In single-course application, joints in succeeding courses shall be offset at least 40 mm so that joints in any two of three consecutive courses are staggered.

(2) In double-course application, joints in the outer course shall be offset from joints in the under-course by not less than 40 mm, and joints in succeeding courses shall be offset not less than 40 mm.

9.27.7.5. Fastening to Lath

(1) When lath is used with double-course application (see Sentence 9.27.5.1.(5)), it shall be spaced according to the exposure and securely fastened to the framing.

(2) The butts of the under-course of the application referred to in Sentence (1) shall rest on the top edge of the lath.

(3) The outer course of the application referred to in Sentence (1) shall be fastened to the lath with nails of sufficient length to penetrate through the lath.

(4) The butts of the shingles or shakes shall be so located that they project not less than 12 mm below the bottom edge of the lath referred to in Sentence (1).

(5) If wood lath is not used, the butts of the under-course shingles or shakes of the application referred to in Sentence (1) shall be located 12 mm above the butts of the outer course.

9.27.7.6. Exposure and Thickness

(1) The exposure and butt thickness of shingles and shakes shall conform to Table 9.27.7.6.

Table 9.27.7.6.
Exposure and Thickness of Wood Shingles and Shakes
\Forming Part of Sentence 9.27.7.6.(1)

Shake or Shingle Length, mm	Maximum Exposure, mm		Minimum Butt Thickness, mm
	Single Coursing	Double Coursing	
400	190	305	10
450	216	356	11
600	292	406	13
Column 1	2	3	4

9.27.8. Plywood

9.27.8.1. Material Standards

(1) Plywood cladding shall be exterior type conforming to,
(a) CSA O115-M, "Hardwood and Decorative Plywood",
(b) CSA O121, "Douglas Fir Plywood",
(c) CSA O151, "Canadian Softwood Plywood", or
(d) CSA O153-M, "Poplar Plywood".

9.27.8.2. Thickness

(1) Plywood cladding shall be not less than 6 mm thick when applied directly to sheathing.

(2) When applied directly to framing or over furring strips, plywood cladding thickness shall conform to Table 9.27.8.2.

(3) The thickness of grooved or textured plywood shall be measured at the point of least thickness.

Table 9.27.8.2.
Minimum Plywood Cladding Thickness
Forming Part of Sentence 9.27.8.2.(2)

Spacing of Supports, mm	Minimum Thickness, mm, where Face Grain Parallel to Supports	Minimum Thickness, mm, where Face Grain at Right Angles to Supports
406	8	6
610	11	8
Column 1	2	3

9.27.8.3. Edge Treatment

(1) The edges of plywood cladding shall be treated with a suitable paint or sealer.

9.27.8.4. Panel Cladding

(1) Plywood applied in panels shall have all edges supported.

(2) Not less than a 2 mm gap shall be provided between panels referred to in Sentence (1).

(3) Vertical joints in cladding referred to in Sentence (1) shall be protected with batten strips or caulking when the plywood joints are not matched.

(4) Horizontal joints in cladding referred to in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.8.5. Lapped Strip Siding

(1) Plywood applied in horizontal lapped strips shall have not less than a 2 mm gap provided at the butted ends, which shall be caulked.

(2) The horizontal joints of siding described in Sentence (1) shall be lapped not less than 25 mm.

(3) Wedges shall be inserted under all vertical butt joints and at all corners when horizontal lapped plywood is applied without sheathing.

9.27.9. Hardboard

9.27.9.1. Material Standards

(1) Factory-finished hardboard cladding shall conform to CAN/CGSB-11.5M, "Hardboard, Precoated, Factory-Finished, for Exterior Cladding".

(2) Hardboard cladding that is not factory finished shall conform to Types 1, 2 or 5 in CAN/CGSB-11.3-M, "Hardboard".

9.27.9.2. Thickness

(1) Type 1 or 2 hardboard cladding shall be not less than,
(a) 6.0 mm thick when applied over sheathing that provides continuous support, and
(b) 7.5 mm thick when applied to furring or framing members not more than 406 mm o.c.

(2) Type 5 hardboard cladding shall be not less than 9.0 mm thick when applied over sheathing that provides continuous support or over furring or framing members spaced not more than 406 mm o.c.

(3) Where hardboard cladding is grooved, the grooves shall not extend more than 1.5 mm into the minimum required thickness. (See Appendix A.)

9.27.9.3. Panel Cladding

(1) Hardboard cladding applied in panels shall have all edges supported with not less than a 5 mm gap provided between sheets.

(2) Vertical joints in cladding described in Sentence (1) shall be protected with batten strips or caulking when the joints are not matched.

(3) Horizontal joints in cladding described in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.9.4. Lapped Strip Siding

(1) Hardboard applied in horizontal lapped strips shall have not less than a 5 mm gap provided at the butted ends, which shall be caulked or otherwise protected with suitable mouldings.

(2) The horizontal joints of siding described in Sentence (1) shall overlap not less than 1 mm per 16 mm width of siding board but not less than 9.5 mm for matched joint siding or 25 mm for lapped siding.

9.27.9.5. Clearance

(1) Not less than 3 mm clearance shall be provided between hardboard siding and door or window frames.

9.27.10. OSB and Waferboard

9.27.10.1. Material Standard

(1) OSB and waferboard cladding shall conform to CSA O437.0, "OSB and Waferboard".

9.27.10.2. Thickness

(1) OSB conforming to O-2 grade shall be not less than 6.0 mm thick where applied directly to sheathing.

(2) OSB conforming to O-2 grade applied directly to framing or over furring strips shall conform to the thickness shown for plywood in Table 9.27.8.2. (See Appendix A.)

(3) OSB conforming to O-1 grade and waferboard conforming to R-1 grade shall be not less than 7.9 mm thick where applied directly to sheathing.

(4) Where applied directly to framing or over furring strips, OSB conforming to O-1 grade and waferboard conforming to R-1 grade shall be not less than,
(a) 9.5 mm thick on supports spaced not more than 406 mm o.c., and
(b) 12.7 mm thick on supports spaced not more than 610 mm o.c.

9.27.10.3. Panel Cladding

(1) OSB and waferboard applied in panels shall have all edges supported and treated with a primer or sealer.

(2) Not less than a 3 mm gap shall be provided between sheets in cladding described in Sentence (1).

(3) Vertical joints in cladding described in Sentence (1) shall be protected with batten strips or caulking when the OSB and waferboard joints are not matched.

(4) Horizontal joints in cladding described in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.10.4. Clearance

(1) At least a 3 mm clearance shall be provided between OSB and waferboard cladding and door or window frames.

9.27.11. Metal

9.27.11.1. Material Standards

(1) Horizontal and vertical strip steel siding, including flashing and trim accessories, shall conform to CAN/CGSB-93.4, "Galvanized Steel and Aluminum-Zinc Alloy Coated Steel Siding, Soffits and Fascia, Prefinished, Residential".

(2) Steel sheet cladding shall have a minimum thickness of 0.3 mm and conform to CAN/CGSB-93.3-M, "Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use".

(3) Horizontal and vertical strip aluminum siding, including flashing and trim accessories, shall conform to CAN/CGSB-93.2-M, "Prefinished Aluminum Siding, Soffits and Fascia, for Residential Use". (See Appendix A.)

(4) Aluminum sheet cladding shall conform to CAN/CGSB-93.1-M, "Sheet, Aluminum Alloy, Prefinished, Residential" and shall have a thickness of not less than 0.58 mm, except that siding supported by backing or sheathing shall have a thickness of not less than 0.46 mm. (See Appendix A.)

9.27.12. Vinyl Siding

9.27.12.1. Material Standard

(1) Vinyl siding, including flashing and trim accessories, shall conform to CAN/CGSB-41.24, "Rigid Vinyl Siding, Soffits and Fascia".

9.27.12.2. Attachment

(1) The attachment of vinyl siding shall conform to the requirements in Subsection 9.27.5. for metal siding.

9.27.13. Exterior Insulation Finish Systems

9.27.13.1. Application

(1) Except as provided in Sentence (2), this Subsection applies to exterior insulation finish systems that,
(a) are covered in the scope of CAN/ULC-S716.1, "Exterior Insulation and Finish Systems (EIFS) – Materials and Systems", and
(b) have a geometrically defined drainage cavity with a minimum cavity depth of 6 mm and an open area equal to not less than 13% of the area of a full-size exterior insulation finish systems panel.

(2) Exterior insulation finish systems not described in Sentence (1) and their components shall comply with Article 5.10.3.1.

9.27.13.2. Materials

(1) The materials used in exterior insulation finish systems shall conform to CAN/ULC-S716.1, "Exterior Insulation and Finish Systems (EIFS) – Materials and Systems".

(2) The substrate on which an exterior insulation finish system is installed shall,
(a) be compatible with that particular system, and
(b) comply with the structural requirements for sheathing materials set out in Section 9.23.

9.27.13.3. Design and Installation

(1) The design of an exterior insulation finish system shall comply with CAN/ULC-S716.3, "Exterior Insulation and Finish Systems (EIFS) – Design Application".

(2) The installation of an exterior insulation finish system shall comply with CAN/ULC-S716.2, "Exterior Insulation and Finish Systems (EIFS) – Installation of EIFS Components and Water Resistive Barrier".

Section 9.28. Stucco

9.28.1. General

9.28.1.1. Sheathing Beneath Stucco

(1) Sheathing shall be provided beneath stucco applied over wood frame walls except as permitted in Article 9.28.4.2.

(2) Where applied beneath stucco, sheathing shall conform to Subsection 9.23.16.

9.28.1.2. Lath and Reinforcing

(1) Stucco lath or reinforcing shall be used to attach stucco to any substrate other than masonry.

(2) Stucco lath or reinforcing shall be used to attach stucco to masonry where,
(a) the masonry is soft-burned tile or brick of less strength than the stucco, or
(b) the masonry surface is not sound, clean and sufficiently rough to provide a good key.

(3) Stucco applied over masonry *chimneys* shall be reinforced.

9.28.1.3. Concrete Masonry Units

(1) Stucco finish shall not be applied over concrete masonry units less than one month old unless the units have been cured by the autoclave process.

9.28.1.4. Clearance Over Ground Level

(1) Stucco shall be not less than 200 mm above finished ground level except when it is applied over concrete or masonry.

9.28.1.5. Flashing and Sealants

(1) Flashing and sealants used with stucco shall conform to Subsections 9.27.3. and 9.27.4., except that if aluminum flashing is used, it shall be separated from the stucco by an impervious membrane or coating.

9.28.2. Stucco Materials

9.28.2.1. Portland Cement

(1) Portland cement shall conform to CAN/CSA-A3001, "Cementitious Materials for Use in Concrete".

9.28.2.2. Aggregate

(1) Aggregate shall be clean, well-graded natural sand or sand manufactured from crushed stone, gravel or air-cooled blast furnace slag and shall contain no significant amounts of deleterious material.

(2) Aggregate grading shall conform to Table 9.28.2.2.

Table 9.28.2.2.
Aggregate Grading for Stucco
Forming Part of Sentence 9.28.2.2.(2)

Sieve Sizes, mm	% Aggregate Passing Sieve	
	Maximum	Minimum
4	—	100
2	—	90
1	90	60
0.5	60	45
0.25	30	10
0.125	5	—
Column 1	2	3

9.28.2.3. Water

(1) Water shall be clean and free of significant amounts of deleterious material.

9.28.3. Fasteners

9.28.3.1. Materials

(1) Fasteners for stucco lath or reinforcing shall be corrosion-resistant and of a material other than aluminum.

9.28.3.2. Nails and Staples

(1) Nails for stucco lath or reinforcing shall be not less than 3.2 mm diam with a head diameter of not less than 11.1 mm.

(2) Staples for stucco lath reinforcing shall be not less than 1.98 mm diam or thickness.

(3) Staples and nails for attaching stucco lath or reinforcing to vertical surfaces shall be of sufficient length to penetrate 25 mm into framing members or to the full depth of the sheathing where the sheathing is used for attachment.

(4) On horizontal surfaces nails for stucco lath or reinforcing shall be not less than 38 mm long.

9.28.4. Stucco Lath

9.28.4.1. Materials

(1) Rib lath or expanded metal stucco mesh shall be,
(a) copper-alloy steel coated with rust-inhibitive paint after fabrication, or
(b) galvanized.

(2) Woven or welded wire mesh shall be galvanized.

9.28.4.2. No Sheathing Required

(1) Sheathing need not be provided beneath stucco where not less than 1.19 mm diam galvanized wire is applied horizontally to the framing at vertical intervals not exceeding 150 mm, or where paper-backed welded wire metal lath is used.

9.28.4.3. Stucco Lath Specifications

(1) Stucco lath shall conform to Table 9.28.4.3.

Table 9.28.4.3.
Stucco Lath(1)
Forming Part of Sentence 9.28.4.3.(1)

Location	Type of Lath	Minimum Diam of Wire, mm	Maximum Mesh Opening	Minimum Mass, kg/m²
Vertical surfaces	Welded or woven wire	1.15	25 mm	—
		1.30	38 mm	—
		1.50	51 mm	—
	Stucco mesh reinforcing (expanded metal)	—	25.8 cm²	0.98
Horizontal surfaces	9.5 mm rib lath	—	—	1.84
	Cedar lath	—	—	—
Column 1	2	3	4	5

Notes to Table 9.28.4.3.
(1) See Appendix A.

9.28.4.4. Self-Furring Devices

(1) Stucco lath shall be held not less than 6 mm away from the backing by means of suitable self-furring devices.

9.28.4.5. Application of Stucco Lath

(1) Stucco lath shall be applied with the long dimension horizontal.

(2) Horizontal and vertical joints in stucco lath shall be lapped not less than 50 mm.

(3) End joints of stucco lath shall be staggered and shall occur over framing members.

(4) External corners of stucco lath shall be reinforced with a vertical strip of lath or reinforcing extending not less than 150 mm on both sides of the corner, or the lath or reinforcing shall extend around corners not less than 150 mm.

9.28.4.6. Fastening

(1) Stucco lath shall be fastened in conformance with Subsection 9.27.5.

(2) Fasteners on vertical surfaces shall be spaced not more than,
(a) 150 mm o.c. vertically and 406 mm o.c. horizontally, or
(b) 100 mm o.c. vertically and 610 mm o.c. horizontally.

(3) Nailing patterns other than those required in Sentence (2) are permitted to be used provided there are not fewer than 20 fasteners per square metre of wall surface.

(4) Fasteners on horizontal surfaces shall be spaced not more than,
(a) 150 mm o.c. along the framing members when members are spaced not more than 406 mm o.c., and
(b) 100 mm o.c. along members when members are spaced not more than 610 mm o.c.

9.28.5. Stucco Mixes

9.28.5.1. Mixes

(1) Stucco mixes shall conform to Table 9.28.5.1.

Table 9.28.5.1.
Stucco Mixes
Forming Part of Sentence 9.28.5.1.(1)

Materials, volume			
Portland Cement	Masonry Cement	Lime	Aggregate
1	—	0.25 to 1	3.25 to 4 parts per part of cementitious material
1	1	—	
Column 1	2	3	4

9.28.5.2. Pigments

(1) Pigment if used shall consist of pure mineral oxides inert to the action of sun, lime and cement.

(2) Pigment shall not exceed 6% of the portland cement by weight.

9.28.5.3. Mixing

(1) Materials shall be thoroughly mixed before and after water is added.

(2) Stucco shall be applied not later than 3 h after the initial mixing.

9.28.6. Stucco Application

9.28.6.1. Low Temperature Conditions

(1) The base for stucco shall be maintained above freezing.

(2) Stucco shall be maintained at a temperature of not less than 10°C during application and for not less than 48 h afterwards.

9.28.6.2. Number of Coats and Total Thickness

(1) Stucco shall be applied with at least two base coats and one finish coat, providing a total thickness of not less than 15 mm, measured from the face of the lath or face of the masonry where no lath is used.

9.28.6.3. First Coat

(1) The first coat shall be not less than 6 mm thick, measured from the face of the lath or masonry, fully embedding the lath.

(2) The surface of the first coat shall be scored to provide a key with the second coat.

9.28.6.4. Second Coat

(1) The second coat shall be not less than 6 mm thick.

(2) The surface of the second coat shall be lightly roughened to provide a key with the finish coat if the finish coat is other than stone dash.

9.28.6.5. Finish Coat

(1) When the finish coat is other than stone dash, the base shall be dampened but not saturated before the finish coat is applied.

(2) The thickness of the finish coat shall be not less than 3 mm.

(3) When a stone dash finish is used, the stone shall be partially embedded in the second coat before the second coat starts to set or stiffen.

Section 9.29. Interior Wall and Ceiling Finishes

9.29.1. General

9.29.1.1. Fire Protection and Sound Control

(1) A wall or ceiling finish shall also conform to the appropriate requirements in Sections 9.10. and 9.11. in addition to the requirements in this Section.

9.29.2. Waterproof Wall Finish

9.29.2.1. Where Required

(1) Waterproof finish shall be provided to a height of not less than,
(a) 1 800 mm above the floor in shower stalls,
(b) 1 200 mm above the rims of bathtubs equipped with showers, and
(c) 400 mm above the rims of bathtubs not equipped with showers.

9.29.2.2. Materials

(1) Waterproof finish shall consist of ceramic, plastic or metal tile, sheet vinyl, tempered hardboard, laminated thermosetting decorative sheets or linoleum.

9.29.3. Wood Furring

9.29.3.1. Size and Spacing of Furring

(1) Wood furring for the attachment of wall and ceiling finishes shall conform to Table 9.29.3.1.

Table 9.29.3.1.
Size and Spacing of Furring
Forming Part of Sentence 9.29.3.1.(1)

Maximum Spacing of Furring, mm	Minimum Size of Furring, mm		
	Maximum Spacing of Furring Supports		
	Continuous Supports	406 mm (o.c.)	610 mm (o.c.)
305	19 × 38	19 × 38	19 × 64
406	19 × 38	19 × 38	19 × 64
610	19 × 38	19 × 64	19 × 89
Column 1	2	3	4

9.29.3.2. Fastening

(1) Furring shall be fastened to the framing or to wood blocks with not less than 51 mm nails.

9.29.4. Plastering

9.29.4.1. Application

(1) Application of plaster wall and ceiling finishes, including installation of metal or gypsum lath, shall conform to CSA A82.30-M, “Interior Furring, Lathing and Gypsum Plastering”.

9.29.5. Gypsum Board Finish (Taped Joints)

9.29.5.1. Application

(1) The requirements for application of gypsum board in this Subsection apply to the single layer application of gypsum board to wood furring or framing using nails or screws.

(2) Gypsum board applications not described in this Subsection shall conform to CSA A82.31-M, “Gypsum Board Application”.

9.29.5.2. Materials

(1) Gypsum products shall conform to,
(a) CAN/CSA-A82.27-M, “Gypsum Board”,
(b) ASTM C1178 / C1178M, “Coated Glass Mat Water-Resistant Gypsum Backing Panel”, or
(c) ASTM C1396 / C1396M, “Gypsum Board”.

9.29.5.3. Maximum Spacing of Supports

(1) Maximum spacing of supports for gypsum board applied as a single layer shall conform to Table 9.29.5.3.

Table 9.29.5.3.
Spacing of Supports for Gypsum Board
Forming Part of Sentence 9.29.5.3.(1)

Thickness, mm	Orientation of Board to Framing	Maximum Spacing of Supports, mm o.c.		
		Walls	Ceilings	
			Painted Finish	Water-Based Texture Finish
Gypsum board conforming to Sentence 9.29.5.2.(1) (except Sections 9 and 12 of ASTM C1396 / C1396M)				
9.5	parallel	—	—	—
	perpendicular	406	406	—
12.7	parallel	610	406	—
	perpendicular	610	610	406
15.9	parallel	610	406	—
	perpendicular	610	610	610
Gypsum board conforming to Clause 9.29.5.2.(1)(c) (only Section 12 of ASTM C1396 / C1396M)				
12.7	parallel	610	406	—
	perpendicular	610	610	610
Column 1	2	3	4	5

9.29.5.4. Support of Insulation

(1) Gypsum board supporting insulation shall be at least 12.7 mm thick.

9.29.5.5. Length of Fasteners

(1) The length of fasteners for gypsum board shall conform to Table 9.29.5.5., except that lesser depths of penetration are permitted for assemblies required to have a *fire-resistance rating* provided it can be shown, on the basis of fire tests, that such depths are adequate for the required rating.

Table 9.29.5.5.
Fastener Penetration into Wood Supports
Forming Part of Sentence 9.29.5.5.(1)

Required Fire-Resistance Rating of Assembly	Minimum Penetration, mm			
	Walls		Ceilings	
	Nails	Screws	Nails	Screws
Not required	20	15	20	15
45 min	20	20	30	30
1 h	20	20	45	45
1.5 h	20	20	60	60
Column 1	2	3	4	5

9.29.5.6. Nails

(1) Nails for fastening gypsum board to wood supports shall conform to,
(a) ASTM F1667, "Driven Fasteners: Nails, Spikes and Staples", or
(b) CSA B111, "Wire Nails, Spikes and Staples".

9.29.5.7. Screws

(1) Screws for fastening gypsum board to wood supports shall conform to ASTM C1002, “Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs”.

9.29.5.8. Spacing of Nails

(1) For single-layer application on ceilings, nails shall be spaced,
(a) not more than 180 mm o.c. on ceiling supports, or
(b) every 300 mm o.c. along ceiling supports, in pairs about 50 mm apart.

(2) Where the ceiling sheets are supported by the wall sheets around the perimeter of the ceiling, this support may be considered as equivalent to nailing at this location.

(3) Except as required by Sentence (4), for single-layer application on walls, nails shall be spaced,
(a) not more than 200 mm o.c. on vertical wall supports, or
(b) every 300 mm o.c. along vertical wall supports, in pairs about 50 mm apart.

(4) For single-layer application on walls, where gypsum board is required to provide bracing, lateral support or fire protection, nails shall be spaced not more than 200 mm o.c. on,
(a) vertical wall supports, and
(b) top and bottom plates.

(5) The uppermost nails on vertical wall supports shall be not more than 200 mm below the ceiling.

(6) Nails shall be located not less than 10 mm from the side or edge of the board.

(7) Nails shall be driven so that the heads do not puncture the paper.

9.29.5.9. Spacing of Screws

(1) For single-layer application on a ceiling, screws shall be spaced not more than 300 mm o.c. on ceiling supports.

(2) Where the ceiling sheets are supported by the wall sheets around the perimeter of the ceiling, this support may be considered as equivalent to screwing at this location.

(3) Except as required by Sentence (4), for single-layer application on walls, screws shall be spaced,
(a) not more than 300 mm o.c. on vertical wall supports where the supports are more than 406 mm o.c., or
(b) not more than 400 mm o.c. on vertical wall supports where the supports are not more than 406 mm o.c.

(4) Except as permitted by Sentence (5), for single-layer application on walls, where gypsum board is required to provide bracing, lateral support or fire protection, screws shall be spaced not more than 300 mm o.c. on,
(a) vertical wall supports, and
(b) top and bottom plates.

(5) Where a *fire-resistance rating* is determined based on Table 1 of MMAH Supplementary Standard SB-3, “Fire and Sound Resistance of Building Assemblies”, Sentence (4) need not apply for the purpose of fire protection.

(6) Screws shall be located not less than 10 mm from the side or edge of the board.

(7) Screws shall be driven so that the heads do not puncture the paper.

9.29.5.10. Low Temperature Conditions

(1) In cold weather, heat shall be provided to maintain a temperature of not below 10°C for 48 h prior to taping and finishing and maintained for not less than 48 h after that.

9.29.6. Plywood Finish

9.29.6.1. Thickness

(1) Except as provided in Sentences (2) and (3), the minimum thickness of plywood interior finish shall conform to Table 9.29.6.1.

(2) A manufacturing tolerance of -0.4 mm may be applied to the thicknesses listed in Table 9.29.6.1.

(3) No minimum thickness is required where plywood is applied over continuous backing.

Table 9.29.6.1.
Thickness of Plywood Interior Finish
Forming Part of Articles 9.29.6.1., 9.29.6.2. and 9.29.9.2.

Maximum Spacing of Supports, mm o.c.	Minimum Thickness, mm(1), on Supports with no Horizontal Blocking	Minimum Thickness, mm(1), on Supports with Blocking at Vertical Intervals not Exceeding 1.2 m
406	4.7	4.0
610	8.0	4.7
Column 1	2	3

Notes to Table 9.29.6.1.
(1) Thickness limits shall apply to the net effective thickness (NET) of grooved, striated, textured and/or embossed panels and to the actual thickness of flat panels.

9.29.6.2. Grooved Plywood

(1) Except as permitted in Sentence (2), where plywood for interior finish is grooved, the grooves shall not extend through the face ply and into the plies below the face ply unless the groove is supported by framing or furring.

(2) If the grain of the face ply is at right angles to the supporting members, the groove is permitted to extend into the plies below the face ply provided the thickness of the plywood exceeds the value shown in Table 9.29.6.1. by an amount equal to not less than the depth of penetration of the grooves into the plies below the face ply.

9.29.6.3. Nails and Staples

(1) Nails for attaching plywood finishes shall not be less than 38 mm casing or finishing nails spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports, except that staples providing equivalent lateral resistance may also be used.

9.29.6.4. Edge Support

(1) All plywood edges shall be supported by furring, blocking or framing.

9.29.7. Hardboard Finish

9.29.7.1. Material Standard

(1) Hardboard shall conform to CAN/CGSB-11.3-M, "Hardboard".

9.29.7.2. Thickness

(1) Hardboard shall be not less than,
(a) 3 mm thick where applied over continuous back-up,
(b) 6 mm thick where applied to supports spaced not more than 406 mm o.c., and
(c) 9 mm thick where applied to supports spaced not more than 610 mm o.c.

9.29.7.3. Nails

(1) Nails for fastening hardboard shall be casing or finishing nails not less than 38 mm long, spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports.

9.29.7.4. Edge Support

(1) All hardboard edges shall be supported by furring, blocking or framing where the back-up is not continuous.

9.29.8. Insulating Fibreboard Finish

9.29.8.1. Material Standard

(1) Insulating fibreboard shall conform to CAN/ULC-S706, "Wood Fibre Thermal Insulation for Buildings".

9.29.8.2. Thickness

(1) Insulating fibreboard sheets shall be not less than 11.1 mm thick on supports not more than 406 mm o.c.

(2) Insulating fibreboard tile shall be not less than 12.7 mm thick on supports spaced not more than 406 mm o.c.

9.29.8.3. Nails

(1) Nails for fastening fibreboard sheets shall be not less than 2.6 mm shank diameter casing or finishing nails of sufficient length to penetrate not less than 20 mm into the supports.

(2) Nails shall be spaced not more than 100 mm o.c. along edge supports and 200 mm o.c. along intermediate supports.

9.29.8.4. Edge Support

(1) All fibreboard edges shall be supported by blocking, furring or framing.

9.29.9. Particleboard, OSB or Waferboard Finish

9.29.9.1. Material Standard

(1) Particleboard finish shall conform to ANSI A208.1, "Particleboard".

(2) OSB or waferboard finish shall conform to,
(a) CAN/CSA-O.325, "Construction Sheathing", or
(b) CSA O437.0, "OSB and Waferboard".

9.29.9.2. Minimum Thickness

(1) Except as provided in Sentences (2) and (3), the minimum thickness of O-2 grade OSB used as an interior finish shall conform to that shown for plywood in Table 9.29.6.1.

(2) Thickness listed in Table 9.29.6.1. shall permit a manufacturing tolerance of -0.4 mm.

(3) No minimum thickness is required where O-2 grade OSB is applied over continuous backing.

(4) OSB conforming to O-1 grade, waferboard conforming to R-1 grade and particleboard shall be,
(a) not less than 6.35 mm thick on supports not more than 406 mm o.c.,
(b) not less than 9.5 mm thick on supports not more than 610 mm o.c., and
(c) not less than 6.35 mm thick on supports not more than 610 mm o.c. in walls where blocking is provided at midwall height.

(5) OSB conforming to CAN/CSA-O325.0, "Construction Sheathing", shall meet the minimum panel mark of,
(a) W16, on supports not more than 406 mm o.c.,
(b) W24, on supports not more than 610 mm o.c., and
(c) W16, on supports not more than 610 mm o.c. where blocking is provided at midwall height.

9.29.9.3. Nails

(1) Nails for fastening particleboard, OSB or waferboard shall be not less than 38 mm casing or finishing nails spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports.

9.29.9.4. Edge Support

(1) All particleboard, OSB or waferboard edges shall be supported by furring, blocking or framing.

9.29.10. Wall Tile Finish

9.29.10.1. Tile Application

(1) Ceramic tile shall be set in a mortar base or applied with an adhesive.

(2) Plastic tile shall be applied with an adhesive.

9.29.10.2. Mortar Base

(1) When ceramic tile is applied to a mortar base the cementitious material shall consist of one part Portland cement to not more than one-quarter part lime by volume.

(2) The cementitious material described in Sentence (1) shall be mixed with no fewer than three nor more than five parts of aggregate per part of cementitious material by volume.

(3) Mortar shall be applied over metal lath or masonry.

(4) Ceramic tile applied to a mortar base shall be thoroughly soaked and pressed into place forcing the mortar into the joints while the tile is wet.

9.29.10.3. Adhesives

(1) Adhesives to attach ceramic and plastic tile shall be applied to the finish coat or brown coat of plaster that has been steel-trowelled to an even surface or to gypsum board or to masonry provided the masonry has an even surface.

9.29.10.4. Moisture Resistant Backing

(1) Ceramic and plastic tile installed on walls around bathtubs or showers shall be applied over moisture resistant backing.

9.29.10.5. Joints Between Tiles and Bathtub

(1) The joints between wall tiles and a bathtub or shower shall be suitably caulked with material conforming to CAN/CGSB-19.22-M, "Mildew Resistant Sealing Compound for Tubs and Tile".

Section 9.30. Flooring

9.30.1. General

9.30.1.1. Required Finish Flooring

(1) Finished flooring shall be provided in all *residential occupancies*.

9.30.1.2. Water Resistance

(1) Finished flooring in bathrooms, kitchens, public entrance halls, laundry and general storage areas shall consist of resilient flooring, felted-synthetic-fibre floor coverings, concrete, terrazzo, ceramic tile, mastic or other types of flooring providing similar degrees of water resistance. (See Appendix A.)

9.30.1.3. Sleepers

(1) Wood sleepers supporting finished flooring over a concrete base supported on the ground shall be not less than 19 mm by 38 mm and shall be treated with a wood preservative.

9.30.1.4. Finish Quality

(1) Finished flooring shall have a surface that is smooth, even and free from roughness or open defects.

9.30.2. Panel-Type Underlay

9.30.2.1. Required Underlay

(1) A panel-type underlay shall be provided under resilient flooring, parquet flooring, ceramic tile, felted-synthetic-fibre floor coverings or carpeting laid over lumber subflooring.

(2) A panel-type underlay shall be provided under resilient flooring, parquet flooring, felted-synthetic-fibre floor coverings or carpeting on panel-type subflooring whose edges are unsupported.

(3) Panel-type underlay shall be provided under ceramic tile applied with adhesive.

(4) Panel-type underlay shall be provided under resilient flooring on waferboard or strandboard subflooring.

9.30.2.2. Materials and Thickness

(1) Panel-type underlay shall be not less than 6 mm thick and shall conform to,
(a) ANSI A208.1, "Particleboard",
(b) CAN/CGSB-11.3-M, "Hardboard",
(c) CSA O115-M, "Hardwood and Decorative Plywood",
(d) CSA O121, "Douglas Fir Plywood",
(e) CSA O151, "Canadian Softwood Plywood",
(f) CSA O153-M, "Poplar Plywood", or
(g) CSA O437.0, "OSB and Waferboard".

9.30.2.3. Fastening

(1) Panel-type underlay shall be fastened to the subfloor with staples, annular grooved flooring nails or spiral nails, spaced not more than 150 mm o.c. along the edges and 200 mm o.c. both ways at other locations.

(2) Nails for panel-type underlay shall be not less than 19 mm long for 6 mm thick underlay and 22 mm long for 7.9 mm thick underlay.

(3) Staples for panel-type underlay shall,
(a) have not less than a 1.2 mm shank diameter or thickness with a 4.7 mm crown, and
(b) be not less than,
  (i) 22 mm long for 6 mm underlay, and
  (ii) 28 mm long for 7.9 mm and 9.5 mm underlay.

9.30.2.4. Joints Offset

(1) Where panel-type underlay is required to be installed over plywood, or OSB or waferboard, the joints in the underlay shall be offset at least 200 mm from the joints in the underlying subfloor.

9.30.2.5. Surface Defects

(1) Underlay beneath resilient or ceramic floors applied with an adhesive shall have all holes or open defects on the surface patched so that the defects will not be transmitted to the finished surface.

9.30.3. Wood Strip Flooring

9.30.3.1. Thickness

(1) The thickness of wood strip flooring shall conform to Table 9.30.3.1.

Table 9.30.3.1.
Thickness of Wood Strip Flooring
Forming Part of Sentence 9.30.3.1.(1)

Type of Flooring	Maximum Joist Spacing, mm	Minimum Thickness of Flooring, mm	
		With Subfloor	No Subfloor
Matched hardwood (interior use only)	406	7.9	19.0
	610	7.9	33.3
Matched softwood (interior or exterior use)	406	19.0	19.0
	610	19.0	31.7
Square edge softwood (exterior use only)	406	—	25.4
	610	—	38.1
Column 1	2	3	4

9.30.3.2. Strip Direction and End Joints

(1) Wood strip flooring shall not be laid parallel to lumber subflooring unless a separate underlay is provided.

(2) If wood strip flooring is applied without a subfloor, it shall be laid at right angles to the joists so that the end joints are staggered and occur over supports or are end matched.

(3) If the flooring is end matched, it shall be laid so that no two adjoining strips break joints in the same space between supports and each strip bears on no fewer than two supports.

9.30.3.3. Nailing

(1) When nails are used, wood strip flooring shall be toe nailed or face nailed with at least one nail per strip at the spacings shown in Table 9.30.3.3., except that face nailed strips of more than 25 mm in width shall have at least two nails per strip.

(2) Face nails shall be countersunk.

Table 9.30.3.3.
Nailing of Wood Strip Flooring
Forming Part of Sentence 9.30.3.3.(1)

Finish Floor Thickness, mm	Minimum Length of Flooring Nails, mm	Maximum Spacing of Flooring Nails, mm
7.9	38(1)	200
11.1	51	300
19.0	57	400
25.4	63	400
31.7	70	600
38.1	83	600
Column 1	2	3

Notes to Table 9.30.3.3.:
(1) See Article 9.30.3.4.

9.30.3.4. Staples

(1) Staples are permitted to be used to fasten wood strip flooring not more than 7.9 mm in thickness and not more than 50 mm in width provided the staples,
(a) are not less than 29 mm long,
(b) have a shank diameter of not less than 1.19 mm,
(c) have a crown of not less than 4.7 mm, and
(d) are spaced not more than 400 mm o.c.

(2) Staples are permitted to be used to fasten wood strip flooring not more than 19 mm in thickness and not more than 83 mm in width provided the staples,
(a) are not less than 51 mm long,
(b) have a shank diameter of not less than 1.82 mm,
(c) have a crown of not less than 12.7 mm, and
(d) are spaced not more than 400 mm o.c.

9.30.4. Parquet Flooring

9.30.4.1. Adhesive

(1) Adhesive used to attach parquet block flooring shall be suitable for bonding wood to the applicable subfloor material.

9.30.5. Resilient Flooring

9.30.5.1. Materials

(1) Resilient flooring used on concrete slabs supported on ground shall consist of asphalt, rubber, vinyl-asbestos, unbacked vinyl or vinyl with an inorganic type backing.

(2) Flooring described in Sentence (1) shall be attached to the base with a suitable waterproof and alkali-resistant adhesive.

9.30.6. Ceramic Tile

9.30.6.1. Substrate

(1) Ceramic tile shall be set in a mortar bed or applied to a sound smooth base with a suitable adhesive.

(2) Panel-type subfloor to which ceramic tile is to be applied with adhesive shall have its edges supported according to Article 9.23.14.3.

Section 9.31. Plumbing Facilities

9.31.1. Scope

9.31.1.1. Application

(1) Except as provided in Sentence (2), this Section applies to *plumbing* facilities and *plumbing systems* serving *dwelling units*.

9.31.2. General

9.31.2.1. General

(1) The *construction* of *plumbing systems* shall conform to Part 7.

9.31.2.2. Corrosion Protection

(1) Metal pipes in contact with cinders or other corrosive material shall be protected by a heavy coating of bitumen or other corrosion protection.

9.31.2.3. Grab Bars

(1) When provided, grab bars shall be capable of resisting a load of not less than 1.3 kN applied vertically or horizontally.

9.31.3. Water Supply and Distribution

9.31.3.1. Required Water Supply

(1) Every *dwelling unit* shall be supplied with a *water distribution system* where a *drinking water system* is available.

9.31.3.2. Required Connections

(1) In a *dwelling unit* with a *water distribution system*, piping for hot and cold water shall be connected to every kitchen sink, lavatory, bathtub, shower, slop sink and laundry area.

(2) Piping for cold water shall be run to every water closet.

9.31.4. Required Facilities

9.31.4.1. Required Fixtures

(1) A *dwelling unit* with a *water distribution system* shall contain,
(a) a kitchen sink,
(b) a lavatory,
(c) a bathtub or shower stall, and
(d) a water closet or a drainless composting toilet.

9.31.4.2. Laundry Fixtures

(1) Laundry facilities or a space for laundry facilities shall be provided in every *dwelling unit* or grouped elsewhere in the *building* in a location conveniently accessible to occupants of every *dwelling unit*.

9.31.4.3. Hot Water Supply

(1) In a *dwelling unit* with a *water distribution system*, a hot water supply shall be provided.

(2) A *water distribution system* supplying hot water to *plumbing fixtures* shall conform to the requirements in Subsection 7.6.5.

9.31.4.4. Floor Drains

(1) A floor drain shall be installed in a *basement* forming part of a *dwelling unit*.

9.31.6. Service Water Heating Facilities

9.31.6.1. Hot Water Temperature

(1) Where a hot water supply is required by Article 9.31.4.3., equipment shall be installed to provide to every *dwelling unit* an adequate supply of service hot water with a temperature range from 45°C to 60°C.

(2) An electric *storage-type service water heater* shall have a minimum set storage temperature of 60°C.

9.31.6.2. Equipment and Installation

(1) Every *service water heater* and its installation shall conform to Part 7.

(3) Where the *building* is in a location where the spectral response acceleration, $S_a(0.2)$, is greater than 0.55, *service water heaters* shall be secured to the structure to resist overturning and displacement. (See Appendix A.)

9.31.6.3. Corrosion-Resistant Coating

(1) Where storage tanks for *service water heaters* are steel, they shall be coated with zinc, vitreous enamel (glass lined), hydraulic cement or other corrosion-resistant material.

9.31.6.4. Fuel-Burning Heaters

(1) Fuel-burning *service water heaters* shall be connected to a *chimney flue* conforming to Section 9.21.

9.31.6.5. Heating Coils

(1) Heating coils of *service water heaters* shall not be installed in a *flue* or in the combustion chamber of a *boiler* or furnace heating a *building*.

Section 9.32. Ventilation

9.32.1. General

9.32.1.1. Application

(1) This Section applies to the ventilation of rooms and spaces in *residential occupancies* by natural ventilation and to self-contained mechanical ventilation systems serving only one *dwelling unit*.

(4) A *storage garage* for more than five cars shall be ventilated in accordance with Part 6.

(5) A clothes dryer *exhaust duct* system shall conform to Part 6.

9.32.1.2. Mechanical Ventilation for Dwelling Units

(1) Every *dwelling unit* that is supplied with electrical power shall be provided with a mechanical ventilation system in accordance with Subsection 9.32.3.

9.32.1.3. Ventilation of Rooms and Spaces

(1) Except as permitted in Sentence (2), rooms or spaces in a *dwelling unit* shall be ventilated by natural means in accordance with Subsection 9.32.2.

(2) The natural ventilation of rooms or spaces required in Sentence (1) may be provided by mechanical means.

(3) Where a room or space is not provided with natural ventilation as described in Sentence (1), mechanical ventilation shall be provided to exhaust inside air from or to introduce outside air to that room or space at the rate of one-half air change per hour if the room or space is mechanically cooled in summer, and one air change per hour if it is not.

9.32.2. Natural Ventilation

9.32.2.1. Natural Ventilation Area

(1) The unobstructed openable ventilation area to the outdoors for rooms and spaces in residential *buildings* ventilated by natural means shall conform to Table 9.32.2.1.

(2) Where a vestibule opens directly off a living or dining room within a *dwelling unit*, ventilation to the outdoors for such rooms may be through the vestibule.

Table 9.32.2.1.
Natural Ventilation
Forming Part of Sentence 9.32.2.1.(1)

Location		Minimum Unobstructed Area
Within a dwelling unit	Bathrooms or water closet rooms	0.09 m^2
	Unfinished basement space	0.2 percent of the floor area
	Dining rooms, living rooms, bedrooms, kitchens, combined rooms, dens, recreation rooms and all other finished rooms	0.28 m^2 per room or combination of rooms
Other than within a dwelling unit	Bathrooms or water closet rooms	0.09 m^2 per water closet
	Sleeping areas	0.14 m^2 per occupant
	Laundry rooms, kitchens, recreation rooms	4 percent of the floor area
	Corridors, storage rooms and other similar public rooms or spaces	2 percent of the floor area
	Unfinished basement space not used on a shared basis	0.2 percent of the floor area
Column 1	2	3

9.32.2.2. Protection from Weather and Insects

(1) Openings for natural ventilation other than windows shall be constructed to provide protection from the weather and insects.

(2) Screening shall be of rust-proof material.

9.32.3. Mechanical Ventilation (See Appendix A.)

9.32.3.1. General

(1) For the purposes of this Subsection a non-solid fuel-fired *appliance* shall be classified as,

(a) direct vented whereby the combustion air is supplied directly from the outdoors to the combustion chamber via a sealed passageway, and the products of combustion are exhausted directly outdoors through an independent sealed vent,

(b) mechanically vented induced draft whereby combustion air is supplied from within the *building* envelope and the products of combustion are positively conveyed to the outdoors by means of a dedicated sealed vent, or
(c) natural draft whereby combustion air is supplied from within the *building* envelope and the products of combustion are conveyed to the outdoors through a *chimney* or Type B vent.

(2) For the purposes of this Subsection a *dwelling unit* shall be categorized as,
(a) Type I when,
  (i) all fuel-fired combustion *appliances* located in the *dwelling unit* are direct vented or, except for fireplaces, are mechanically vented induced draft, and
  (ii) the *dwelling unit* does not contain a solid fuel-fired combustion *appliance*,
(b) Type II when a solid fuel-fired combustion *appliance* is installed in a Type I *dwelling unit*,
(c) Type III when a mechanically vented induced draft non-solid fuel-fired fireplace or a natural draft *appliance* is present, or
(d) Type IV when *electric space heating* is present.

9.32.3.2. Required Mechanical Ventilation

(1) The mechanical ventilation system required in Article 9.32.1.2. shall comply with,
(a) Part 6, or
(b) this Subsection for a mechanical ventilation system in a Type I, Type II or Type IV *dwelling unit*.

9.32.3.3. Total Ventilation Capacity

(1) The minimum total ventilation capacity of the ventilation system required in Clause 9.32.3.2.(1)(b) shall be the sum of the individual room capacities given in Table 9.32.3.3.

Table 9.32.3.3.
Ventilation Capacity
Forming Part of Sentence 9.32.3.3.(1)

Room	Capacity, L/s
Master bedroom(1)	10
Other bedrooms	5
Living room(2)	5
Dining room(2)	5
Kitchen	5
Family room(2)	5
Recreation room	5
Basement(3)	10
Other habitable rooms(4)	5
Bathroom or water closet room	5
Laundry room	5
Utility room	5
Column 1	2

Notes to Table 9.32.3.3.:
(1) At least one bedroom in each dwelling unit shall be designated as the master bedroom.
(2) Ventilation capacities assigned to any combined living/dining or family/dining space shall be determined as if the spaces were individual rooms.
(3) Where a basement incorporates rooms of the types designated in this Table, the assigned ventilation capacities for each room shall be as specified for those types of rooms. Basement areas used for other purposes that exceed ⅔ of the total basement floor area shall be assigned a fan capacity of 10 L/s. Those that are less than ⅔ of the total floor area shall be assigned 5 L/s.
(4) Other habitable rooms shall be assigned a ventilation capacity of 5 L/s. This does not include spaces intended solely for access, egress, storage or service equipment.

9.32.3.4. Principal Exhaust

(1) A principal exhaust fan shall be installed and shall be rated to provide not less than the capacity given in Table 9.32.3.4.A.

Table 9.32.3.4.A.
Principal Exhaust Fan Capacity
Forming Part of Sentence 9.32.3.4.(1)

Number of Bedrooms in Dwelling Unit	Capacity, L/s
1	15
2	22.5
3	30
4	37.5
5	45
More than 5	System must comply with Sentence 6.2.1.1.(1)
Column 1	2

(2) Except as permitted in Sentence (3), the principal exhaust fan shall be controlled by a manual switch.

(3) A principal exhaust fan required under this Article may be controlled by a dehumidistat or other automatic control device where the manual switch required in Sentence (2) is capable of activating the fan regardless of the setting of the automatic control.

(4) The switches required in Sentences (2) and (3) shall be centrally located in the *dwelling unit* and shall be identified with the words **VENTILATION FAN.**

(5) The principal exhaust required in this Article may be provided by means of a heat recovery ventilator installed in accordance with Article 9.32.3.11.

(6) Where the installed capacity of the principal exhaust fan exceeds the minimum capacity required in Sentence (1) by more than 50%, the control required in Sentence (2) shall include provision to allow reduction of the flow to within ±10% of the minimum capacity specified in Sentence (1).

(7) Where an exhaust air intake for the principal exhaust fan is connected directly to the duct system of a forced air heating system or other central air circulating system, it shall,
(a) be connected to the return air side of the system, and
(b) be connected not less than 1 000 mm upstream from any outdoor air supply duct.

(8) Where an exhaust air intake for the principal exhaust fan is located in the kitchen, it shall be located in the ceiling or on the wall within 300 mm of the ceiling.

(9) Single or multiple *exhaust ducts* serving the principal exhaust fan required by Sentence (1) shall be sized according to Part 6 except that they may be sized according to Table 9.32.3.4.B. where,
(a) the longest total duct length, from intake grille to outdoor hood, does not exceed 12 m, and
(b) the number of elbows does not exceed 4, but, in any case, they shall not be smaller than recommended by the manufacturer of the fan.

(10) In applying Table 9.32.3.4.B.,
(a) where there is more than one exhaust air inlet duct connected directly to the fan, the diameter of the inlet ducts may be decreased by 25 mm, and
(b) where the *exhaust duct* is connected to the duct system of a forced air heating system, the duct diameter shall be increased by 25 mm.

Table 9.32.3.4.B.
Principal Exhaust Duct Size
Forming Part of Sentences 9.32.3.4.(9) and (10)

Number of Bedrooms in Dwelling Unit	Minimum Exhaust Duct Diameter			
	Ducts Connected to Inlet and Outlet of Principal Exhaust Fan		Ducts Connected to One Side Only of Principal Exhaust Fan	
	Smooth Duct, mm	Flexible Duct, mm	Smooth Duct, mm	Flexible Duct, mm
1	100	125	100	125
2	125	150	125	150
3	125	150	150	175
4	150	175	150	175
5	150	175	150	175
More than 5	Part 6 design	Part 6 design	Part 6 design	Part 6 design
Column 1	2	3	4	5

9.32.3.5. Supplemental Exhaust

(1) Additional supplemental exhaust capacity shall be installed as necessary so that the total capacity of all kitchen, bathroom, water closet room and other supplemental exhaust air intakes is not less than the total ventilation capacity, as required in Article 9.32.3.3., minus the principal exhaust fan capacity, as required in Article 9.32.3.4.

(2) An exhaust air intake shall be installed in each kitchen, bathroom and water closet room.

(3) Where the intake for a supplemental exhaust fan, other than a cooking *appliance* exhaust fan serving a *cooktop*, is installed in a kitchen, it shall be installed in the ceiling or on the wall within 300 mm of the ceiling.

(4) *Exhaust ducts* serving the required kitchen, bathroom, water closet room and other supplemental exhaust air intakes shall be sized according to Part 6 except that they may be sized according to Table 9.32.3.5. where,
(a) the total duct length does not exceed 9 m, and
(b) the number of elbows does not exceed 4,

but, in any case, they shall not be smaller than recommended by the manufacturer of the fans.

Table 9.32.3.5.
Kitchen, Bathroom and Water Closet Room Exhaust Duct Size
Forming Part of Sentence 9.32.3.5.(4)

Fan Capacity, L/s	Minimum Exhaust Duct Diameter(1)	
	Ducts Connected to Inlet and Outlet of Exhaust Fan, mm	Ducts Connected to One Side Only of Exhaust Fan, mm
25	125	125
50	150	150
Column 1	2	3

Notes to Table 9.32.3.5.:
(1) Where flexible duct is used, the duct diameter shall be increased by 25 mm.

(5) A supplemental exhaust fan required by this Article shall be controlled by a manual switch located in the room served by the exhaust fan.

(6) Where the supplemental exhaust is provided by an exhaust fan serving multiple exhaust air intakes required in rooms described in Sentence (2), the exhaust fan shall be controlled by a manual switch located in each room served by that exhaust fan and wired in parallel.

(7) Where the supplemental exhaust is provided by a principal exhaust fan serving multiple exhaust air intakes required in rooms described in Sentence (2), the principal exhaust fan shall be controlled by a manual switch located in each room served by that exhaust fan and wired in parallel with the manual switch required in Sentence 9.32.3.4.(4).

(8) Where a supplemental fan required by this Article is controlled by a dehumidistat or other automatic control device in addition to the manual switch required by Sentences (5) to (7), the manual switch shall be capable of activating the fan regardless of the setting of the automatic control.

(9) Supplemental exhaust required in this Article may be provided by means of a heat recovery ventilator installed in accordance with Article 9.32.3.11.

9.32.3.6. Ventilation Systems Coupled With Forced Air Heating Systems

(1) This Article applies to a mechanical ventilation system in a *dwelling unit* that contains a forced air heating system which is used for delivery of ventilation air.

(2) In a Type I *dwelling unit*, a ventilation supply inlet is not required.

(3) In a Type II *dwelling unit*, the mechanical ventilation system shall include a heat recovery ventilator, coupled to the forced air heating system, installed in accordance with Article 9.32.3.11.

(4) The forced air heating system circulation fan shall be controlled by a manual switch located adjacent to the ventilation fan switch required in Sentence 9.32.3.4.(4).

(5) The switch required in Sentence (4) shall be identified by the words **CIRCULATION FAN**.

9.32.3.7. Ventilation Systems Not Coupled With Forced Air Heating Systems

(1) This Article applies to a mechanical ventilation system in a *dwelling unit* that,
(a) does not contain a forced air heating system, or
(b) contains a forced air heating system which is not used for circulation of the ventilation air.

(2) The mechanical ventilation system shall introduce air to and circulate air throughout the *dwelling unit* in compliance with this Article.

(3) The mechanical system in this Article shall include a heat recovery ventilator installed in accordance with Article 9.32.3.11.

(4) Outdoor air shall be distributed by a ductwork system from the heat recovery ventilator required in Sentence (3) to each bedroom, to any *storey* without a bedroom and, if there is no *storey* without a bedroom, to the principal living area.

(5) A *supply duct* from the outdoors to the heat recovery ventilator required in Sentence (3) and a main distribution trunk duct shall be provided and shall be sized according to Part 6, except that the *supply duct* and the main distribution trunk duct may be sized according to Table 9.32.3.7.A. where,
(a) the total duct length from the outdoor hood to any supply register does not exceed 21 m, and
(b) the total number of fittings does not exceed 8.

Table 9.32.3.7.A.
Minimum Outdoor Air Supply and Main Trunk Duct Sizes
Forming Part of Sentence 9.32.3.7.(5)

Number of Bedrooms in Dwelling Unit	Minimum Outdoor Air Supply and Main Distribution Trunk Duct Diameter, mm
1	150
2	150
3	175
4	175
5	175
More than 5	System must comply with Sentence 6.2.1.1.(1)
Column 1	2

(6) The outside air *supply duct* required by Sentence (5) shall not be considered to provide combustion and/or dilution air to fuel-burning *appliances*.

(7) Branch supply ducts leading from the main distribution trunk duct required by Sentence (5) to the rooms to which outdoor air is to be distributed shall be provided and shall be sized according to Part 6, except that the branch supply ducts may be sized according to Table 9.32.3.7.B. where,
(a) the total duct length from the outdoor hood to any supply register does not exceed 21 m, and
(b) the total number of fittings does not exceed 8.

Table 9.32.3.7.B.
Minimum Branch Supply Duct Sizes
Forming Part of Sentence 9.32.3.7.(7)

Room, Space or Storey Served	Minimum Branch Supply Duct Diameter, mm	
	1 and 2 Bedroom Dwelling Units	3, 4 and 5 Bedroom Dwelling Units
Master bedroom	100	100
Other bedrooms	75	75
Storey with no bedrooms or living area	75	100
Column 1	2	3

(8) In applying Sentence (7), where the *dwelling unit* has more than 5 bedrooms, ducting shall be sized according to Part 6.

(9) All branch *supply ducts* that are not fitted with diffusers with adjustable balance stops shall be supplied with accessible dampers that can be adjusted and fixed in their adjusted positions and that include devices to indicate the positions of the dampers.

(10) Provision shall be made for the free flow of air to all rooms by leaving gaps beneath doors, using louvred doors or installing grilles in doors.

9.32.3.8. Protection Against Depressurization

(1) When determining the need to provide protection against depressurization, consideration must be given to,
(a) whether the presence of *soil* gas is deemed to be a problem, and
(b) the presence of solid fuel-fired combustion *appliances*.

(2) Where a solid fuel-fired combustion *appliance* is installed, the ventilation system shall include a heat recovery ventilator that is designed to operate so that the flow of exhaust air does not exceed the flow of intake air in any operating mode, and that complies with the requirements of Article 9.32.3.11.

(3) The provision of make-up air is not required for mechanical exhausting devices operating a subfloor depressurization system installed for the purpose of reducing the risk of radon ingress.

9.32.3.9. Fan Ratings

(1) Except as provided in Sentence (4), capacity ratings for required fans shall be determined in accordance with,
(a) CAN/CSA-C260-M, "Rating the Performance of Residential Mechanical Ventilating Equipment", or
(b) HVI 916, "Airflow Test Procedure".

(2) Sound ratings for required fans shall be determined in accordance with,
(a) CAN/CSA-C260-M, "Rating the Performance of Residential Mechanical Ventilating Equipment", or
(b) HVI 915, "Procedure for Loudness Rating of Residential Fan Products".

(3) Capacity ratings for required fans shall be based on a static pressure differential of 50 Pa, 25 Pa or 7.5 Pa depending on whether the fan is installed with ductwork connected on both sides, one side or neither side, respectively.

(4) Except for heat recovery ventilators, exhaust fans required to make up any part of the total ventilation capacity required by Article 9.32.3.3. shall have a sound rating not greater than that specified in Table 9.32.3.9.

Table 9.32.3.9.
Fan Sound Rating
Forming Part of Sentence 9.32.3.9.(4)

Fan Application	Maximum Sound Rating, sones	
	Rated according to CAN/CSA-C260-M	Rated according to HVI 915
Principal exhaust fan	2.0	2.5
Supplemental exhaust fans installed in bathrooms and water closet rooms and their make-up air fans	2.5	3.5
Supplemental exhaust fans installed in kitchens and their make-up air fans	no rating required	no rating required
Column 1	2	3

(5) Required fans shall be installed according to the manufacturer's instructions.

(6) Mechanical ventilation devices shall conform to CSA C22.2 No. 113-M, "Fans and Ventilators".

9.32.3.10. Ducts

(1) Ventilation ducts shall conform to the requirements of Part 6 for *supply ducts*, except that *exhaust ducts* that serve only a bathroom or water closet room may be of *combustible* material provided the duct is reasonably airtight and constructed of a material impervious to water.

(2) *Exhaust ducts* shall not discharge into heated or unheated enclosed spaces.

(3) Where an *exhaust duct* passes through or is adjacent to unheated space, the duct shall be insulated to not less than RSI 0.5.

(4) Where a duct carrying outdoor air that is not tempered or not mixed with indoor air passes through heated space, it shall be insulated to not less than RSI 0.5 except that, where such a duct is exposed in the heated space for more than 3 m of length in the heated space, it shall be,
(a) insulated to not less than the values listed in Table 9.32.3.10.A., and
(b) provided with a *vapour barrier*.

(5) A kitchen *exhaust duct* not equipped with a filter at the inlet end shall be designed and installed so that the entire duct can be cleaned.

(6) Ductwork for cooking *appliance* exhaust fans shall,
(a) be of *noncombustible*, corrosion-resistant material, and
(b) lead directly to the outdoors without connection to other exhaust fans or ducts.

(7) Ductwork for cooking *appliance* exhaust fans shall be equipped with a grease filter at the intake.

(8) All ductwork shall be permanently supported or clipped to prevent sagging, excessive movement and vibration.

(9) All ducting connected to supply and exhaust fans shall be constructed so as to inhibit air leakage at joints.

(10) Where rectangular duct is used in place of round duct, it shall be selected according to Table 9.32.3.10.B.

Table 9.32.3.10.A.
Insulation of Ducts Carrying Outdoor Air
Forming Part of Sentence 9.32.3.10.(4)

Outside Winter Design Temperature as per MMAH Supplementary Standard SB-1, "Climatic and Seismic Data"(1), °C	Minimum Thermal Resistance, RSI
–7 to –11	0.5
–12 to –17	0.9
–18 to –24	1.2
–25 to –29	1.4
–30 to –34	1.8
–35 and colder	2.1
Column 1	2

Notes to Table 9.32.3.10.A.:
(1) The outside winter design temperatures shall be those listed for the January 2.5 percent values.

Table 9.32.3.10.B.
Equivalent Duct Sizes
Forming Part of Sentence 9.32.3.10.(10)

Required Round Duct Size, mm	Permitted Equivalent Rectangular Duct Size, mm			
	Stack Duct	100 mm Depth	125 mm Depth	150 mm Depth
75	82 × 250	57 × 100		
100	82 × 250	89 × 100	75 × 125	75 × 150
125	82 × 250	125 × 100	100 × 125	89 × 150
150	82 × 300	200 × 100	150 × 125	125 × 150
175	82 × 350	275 × 100	200 × 125	175 × 150
More than 175	Part 6 design	Part 6 design	Part 6 design	Part 6 design
Column 1	2	3	4	5

9.32.3.11. Heat Recovery Ventilators

(1) Where a heat recovery ventilator is installed to provide all or part of the requirements of this Subsection, this Article shall apply.

(2) Heat recovery ventilators shall be designed to provide a minimum 55% sensible heat recovery efficiency when tested to the low temperature thermal and ventilation performance test method set out in CAN/CSA-C439, "Rating the Performance of Heat/Energy-Recovery Ventilators", at a Station 1 test temperature of –25°C at an air flow not less than 30 L/s.

(3) Where a heat recovery ventilator is connected to a forced air heating system, the supply side of the ventilator shall be directly connected to the return air side of the forced air heating system.

(4) Two or more heat recovery ventilators shall not be connected in parallel air flow to a common air *supply duct* unless specifically recommended by the manufacturer.

(5) Two or more heat recovery ventilators shall not be connected in parallel air flow to a common downstream *exhaust duct.*

(6) Heat recovery ventilators installed in unheated spaces shall be installed so as to avoid condensation of moisture on fans and motors in exhaust air, in accordance with the manufacturer's instructions.

(7) All start-up procedures recommended by the manufacturer including air balancing and air-flow determination shall be followed.

(8) Free flow of condensate shall be provided in accordance with the manufacturer's recommendations or, in their absence, a condensate drain of minimum ½ inch nominal pipe size pitched in the direction of flow and complete with a trap or condensate pump with sufficient capacity shall be installed.

(9) The heat recovery ventilator and all condensate lines shall be installed in a space where the ambient temperature will not adversely affect the operation of the system.

(10) When operating at the rate required in Article 9.32.3.4., the supply and exhaust airflow rates of the heat recovery ventilator shall be balanced so that the value of the lesser flow shall be at least 90% of the value of the greater flow, unless otherwise recommended by the manufacturer.

9.32.3.12. Outdoor Intake and Exhaust Openings

(1) Separate air intake and exhaust outlet openings, when located on the same wall or roof, shall be installed so as to avoid contamination of the ventilation air by the exhaust air.

(2) Intake openings shall be located so as to avoid contamination of the ventilation air from other local sources such as automobile exhausts and exhaust from adjacent *buildings.*

(3) The distance from the bottom of an air intake opening to finished ground level or to any nearer and lower permanent horizontal surface shall be not less than 450 mm or the depth of expected snow accumulation, whichever is greater.

(4) The distance separating air intakes from *building* envelope penetrations that are potential sources of contaminants, such as *gas vents* or oil fill pipes, shall be not less than 900 mm.

(5) Air intakes shall be clearly labelled as such for identification from locations outside the *dwelling unit.*

(6) The distance from the bottom of an exhaust outlet to finished ground level or to any nearer and lower permanent horizontal surface shall be not less than 100 mm.

(7) Where air intake and exhaust openings are in exposed locations, provision shall be made to protect them from the entry of precipitation by the use of louvres, weather cowls or other suitable protection.

(8) Air intake openings shall incorporate screens or grilles to protect against the entry of animals and insects.

(9) Except for exhaust outlets serving heat recovery ventilators, exhaust outlets shall incorporate backdraft dampers.

(10) Except for clothes dryers, exhaust outlets shall be fitted with screens of mesh not larger than 15 mm, except where climatic conditions may require larger openings.

(11) Where a screen or grille required by Sentences (8) and (10) has a screen mesh less than 6 mm, the screen or grille shall be removable for cleaning.

(12) The gross area of the screens or grilles installed in intake and exhaust openings shall be three times that of the duct served.

(13) Screens and grilles shall be of corrosion-resistant material.

(14) The net free area of an air intake or exhaust outlet shall be equal to or greater than the cross-sectional area of the duct served.

9.32.3.13. Installation

(1) Installation of fans and heat recovery ventilators shall be in accordance with manufacturer's instructions for minimizing noise and vibration transmission and achieving the required sound rating.

(2) Where flow-regulating dampers are required, they shall be adjustable and accessible without requiring the removal of fans, motors, or insulating materials and without the need for specialized tools.

(3) Ventilation equipment shall be accessible for inspection, maintenance, repair and cleaning.

(4) Ventilation equipment installed in unheated spaces shall be installed so as to avoid condensation of moisture on fans and motors in accordance with the manufacturer's instructions.

Section 9.33. Heating and Air-Conditioning

9.33.1. General

9.33.1.1. Design and Installation Requirements (See Appendix A.)

(1) The design and installation of central heating systems, including requirements for combustion air, shall conform to Part 6 and this Section.

(2) The design and installation of *air-conditioning* systems shall conform to Part 6.

(3) Repairs or component replacements that change the capacity or extent of safety of an existing heating, ventilating or *air-conditioning* system and that alter the method of operation shall conform to this Code.

9.33.1.2. Solid Fuel-Burning Appliances

(1) The design, construction and installation, including the provision of combustion air, of solid-fuel burning *appliances* and equipment, including *stoves, cooktops* and *space heaters*, shall conform to CAN/CSA-B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment". (See Appendix A.)

(2) Solid fuel-burning *stoves*, *furnaces* and hydronic heating systems designed to burn solid fuels, other than coal, shall conform to the particulate emission limits of,
(a) CSA B415.1, "Performance Testing of Solid-Fuel-Burning Heating Appliances", or
(b) the "Standards of Performance for New Residential Wood Heaters", set out in Subpart AAA of Part 60 of Title 40 of the Code of Federal Regulations, published by the United States Environmental Protection Agency, as it read on November 1, 2013.

9.33.1.3. Structural Movement

(1) Where the *building* is in a location where the spectral response acceleration, $S_a(0.2)$, is greater than 0.55, heating and *air-conditioning* equipment with fuel or power connections shall be secured to the structure to resist overturning and displacement.

9.33.2. Required Heating Systems

9.33.2.1. Residential Heating Systems

(1) Residential *buildings* intended for use in the winter months on a continuing basis shall be equipped with heating facilities conforming to this Section.

9.33.2.2. Equipment Sizing

(1) The heating system capacity shall be based on the heating load calculated in accordance with Sentence 6.2.1.1.(1).

(2) Where a cooling system is installed, the cooling system capacity shall be based on the cooling load calculated in accordance with Sentence 6.2.1.1.(1).

(3) The heating and cooling equipment capacities shall be determined in accordance with the requirements of CSA F280, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances".

9.33.3. Design Temperatures

9.33.3.1. Indoor Design Temperatures

(1) At the outside design temperature, required heating facilities shall be capable of maintaining an indoor air temperature of not less than,
(a) 22°C in all living spaces,
(b) 22°C in unfinished *basements*, and
(c) 15°C in heated crawl spaces.

9.33.3.2. Outdoor Design Temperatures

(1) The outdoor conditions to be used in designing heating, ventilating and *air-conditioning* systems shall be the appropriate values for the location as set out in MMAH Supplementary Standard SB-1, "Climatic and Seismic Data", using 2.5 percent design temperature criteria.

9.33.4. Carbon Monoxide Alarms (See Appendix A.)

9.33.4.1. Application

(1) This Subsection applies to every *building* that,
(a) contains a *residential occupancy*, and
(b) contains a fuel-burning *appliance* or a *storage garage*.

9.33.4.2. Location of Carbon Monoxide Alarms

(1) Where a fuel-burning *appliance* is installed in a *suite* of *residential occupancy*, a carbon monoxide alarm shall be installed adjacent to each sleeping area in the *suite*.

(3) Where a *storage garage* is located in a *building* containing a *residential occupancy*, a carbon monoxide alarm shall be installed adjacent to each sleeping area in every *suite* of *residential occupancy* that is adjacent to the *storage garage*.

(4) Where a *storage garage* serves only the *dwelling unit* to which it is attached or built in, a carbon monoxide alarm shall be installed adjacent to each sleeping area in the *dwelling unit*.

(5) A carbon monoxide alarm shall be mechanically fixed,
(a) at the manufacturer's recommended height, or
(b) in the absence of specific instructions, on or near the ceiling.

9.33.4.3. Installation and Conformance to Standards

(1) The carbon monoxide alarm required by Article 9.33.4.2. shall,
(a) except as permitted in Sentence (2), be permanently connected to an electrical circuit and shall have no disconnect switch between the overcurrent device and the carbon monoxide alarm,
(b) be wired so that its activation will activate all carbon monoxide alarms within the *suite*, where located within a *suite* of *residential occupancy*,
(c) be equipped with an alarm that is audible within bedrooms when the intervening doors are closed, where located adjacent to a sleeping area, and
(d) conform to,
  (i) CAN/CSA-6.19, "Residential Carbon Monoxide Alarming Devices", or
  (ii) UL 2034, "Single and Multiple Station Carbon Monoxide Alarms".

(2) Where the *building* is not supplied with electrical power, carbon monoxide alarms are permitted to be battery operated.

Section 9.34. Electrical Facilities

9.34.1. General

9.34.1.1. Reserved

9.34.1.2. Required Facilities

(1) Where electrical services are available, electrical facilities shall be provided for every *building* in conformance with this Section.

9.34.1.3. Location of Equipment in Public Areas

(1) Entrance switches, meters, panel boxes, splitter boxes, time clocks and other similar equipment shall not be located in any public area unless adequate precautions are taken to prevent interference with the equipment.

9.34.1.4. Recessed Lighting Fixtures

(1) Recessed lighting fixtures shall not be located in insulated ceilings unless the fixtures are designed for such installations.

9.34.2. Lighting Outlets

9.34.2.1. Lighting of Entrances

(1) An exterior lighting outlet with fixture controlled by a wall switch located within the *building* shall be provided at every entrance to *buildings* of *residential occupancy*.

9.34.2.2. Outlets in Dwelling Units

(1) Except as provided in Sentence (2), a lighting outlet with fixture controlled by a wall switch shall be provided in kitchens, bedrooms, living rooms, utility rooms, laundry rooms, dining rooms, bathrooms, water closet rooms, vestibules and hallways in *dwelling units*.

(2) Where a receptacle controlled by a wall switch is provided in bedrooms or living rooms, such rooms need not conform to the requirements of Sentence (1).

9.34.2.3. Stairways

(1) Every stairway shall be lighted.

(2) Except as provided in Sentence (3), 3-way wall switches located at the head and foot of every stairway shall be provided to control at least one lighting outlet with fixture for stairways with four or more risers in *dwelling units*.

(3) The stairway lighting for *basements* that do not contain finished space or lead to an outside entrance or built-in garage and that serve not more than one *dwelling unit* is permitted to be controlled by a single switch located at the head of the stairs.

9.34.2.4. Basements

(1) A lighting outlet with fixture shall be provided for each 30 m^2 of floor area or fraction of it in unfinished *basements*.

(2) The outlet required in Sentence (1) nearest the stairs shall be controlled by a wall switch located at the head of the stairs.

9.34.2.5. Storage Rooms

(1) A lighting outlet with fixture shall be provided in storage rooms.

9.34.2.6. Garages and Carports

(1) A lighting outlet with fixture shall be provided for an attached, built-in or detached garage or carport.

(2) Except as provided in Sentence (3), lighting outlets required in Sentence (1) shall be controlled by a wall switch near the doorway.

(3) Where the lighting outlet and fixture required in Sentence (1) are ceiling mounted above an area not normally occupied by a parked car, or are wall mounted, a fixture with a built-in switch is permitted to be used.

(4) Where a carport is lighted by a light at the entrance to a *dwelling unit*, additional carport lighting is not required.

Section 9.35. Garages and Carports

9.35.1. Scope

9.35.1.1. Application

(1) This Section applies to garages and carports serving a single *dwelling unit.*

9.35.1.2. Construction Requirements

(1) The construction of a garage or carport shall conform to the requirements for other *buildings* in this Part except as provided in this Section.

9.35.2. General

9.35.2.1. Carport Considered to be Garage

(1) Where a roofed enclosure used for the storage or parking of motor vehicles has more than 60 percent of the total perimeter enclosed by walls, doors or windows, the enclosure shall be considered a garage.

9.35.2.2. Garage Floor

(1) Where an attached or built-in garage is provided, the garage floor shall be sloped to drain liquids to the outdoors.

9.35.3. Foundations

9.35.3.1. Foundation Required

(1) Except as permitted in this Subsection, *foundations* conforming to Sections 9.12. and 9.15. shall be provided for the support of carport and garage super-structures, including that portion beneath garage doors.

9.35.3.2. Protection from Damage Due to Soil Movement

(1) In clay-type *soils* subject to significant movement with a change in *soil* moisture content, the *foundation* depth of carports or garages connected to a *dwelling unit* directly or by a breezeway shall be approximately the same depth as the main *building foundation.*

(2) Where slab-on-ground construction is used, a construction joint shall be provided between the main *building* slab and the garage or breezeway or carport slab.

(3) Except as provided in Section 9.12., *foundations* for attached unheated garages or carports shall be below frost level.

9.35.3.3. Small Garages

(1) Detached garages of less than 55 m^2 floor area and not more than 1 *storey* in height may be supported on wood mud sills provided the garage is not of masonry or masonry veneer construction.

9.35.3.4. Column Piers

(1) Piers for the support of carport columns shall extend not less than 150 mm above ground level.

(2) Piers referred to in Sentence (1) shall project not less than 25 mm beyond the base of the column but in no case be less than 190 mm by 190 mm in size.

9.35.4. Walls and Columns

9.35.4.1. Interior Finish

(1) Interior finish need not be applied to garage and carport walls.

9.35.4.2. Columns

(1) Columns for garages and carports shall conform to Section 9.17., except that 89 mm by 89 mm wood columns may be used.

9.35.4.3. Anchorage

(1) Garage or carport walls and columns shall be anchored to the *foundation* to resist wind uplift in conformance with Subsection 9.23.6., except that where a garage is supported on the surface of the ground, ground anchors shall be provided to resist wind uplift.

Section 9.37. Log Construction

9.37.1. General

9.37.1.1. Material Requirements

(1) Logs that are sound and free of fractures may be used for *foundations*, beams, posts and similar members, provided it can be shown by a structural analysis or tests or previous experience that the strength of the member is adequate for its intended purposes.

9.37.1.2. Requirement for Wood Preservative

(1) The portion of any log coming in contact with masonry or concrete at or below *grade* shall be treated with a wood preservative to prevent decay.

9.37.1.3. Exterior Joints

(1) All exterior joints between logs shall be rendered water-tight by methods such as machined joints, oakum packing, cement parging, chinking, caulking or a combination of these.

9.37.2. Walls

9.37.2.1. Logs

(1) Walls may be built of natural or manufactured logs.

9.37.2.2. Attachment of Logs

(1) Walls made of logs in a horizontal position shall have interlocking intersections that will prevent the collection of water in the joints, or the horizontal logs shall butt to a vertical corner post to which the horizontal logs shall be firmly attached.

9.37.2.3. Joining Logs

(1) Each log in a horizontal position shall be scribed as close as possible to its bearer and fastened to the bearer in at least three places throughout its length, by dowels, continuous machined joints, vertical framing members or interlocking intersections or any combination of these, but in no case shall the distance between fastenings exceed 1 800 mm.

9.37.2.4. Vertical Logs

(1) Each log in a wall built of vertical logs shall be scribed to fit as closely as possible to the adjacent logs.

9.37.2.5. Plates

(1) Logs used in a vertical position shall have a plate at the top and a plate at the bottom and the plates shall be at least as wide as the largest end diameter of any of the logs.

9.37.3. Lintels

9.37.3.1. Support Over Openings

(1) Logs placed in vertical position shall be supported over window and door openings by lintels meeting the requirements of Tables A-12 to A-16.

9.37.3.2. Clearance

(1) At every opening in a wall made of logs in a horizontal position where shrinkage can occur there shall be a clearance between the rough buck header and the lintel log of not less than 13 mm in width for each 300 mm of height to allow for settlement.

Section 9.39. Reinforced Concrete Slabs (See Appendix A.)

9.39.1. Scope

9.39.1.1. Application

(1) This Section applies to,
(a) reinforced concrete slabs that are suspended over cold rooms in *basements*, and are supported by *foundation* walls along the perimeter of the slab with no additional interior supports, and
(b) slabs in which the clear span between supporting walls is not more than 2.5 m along the shortest dimension of the slab.

(2) Slabs for conditions other than described in Sentence (1) shall be designed in accordance with Part 4.

(3) This Section does not apply to reinforced concrete slabs intended to support motor vehicles.

9.39.1.2. Concrete

(1) Concrete shall conform to Section 9.3.

9.39.1.3. Reinforcing Steel

(1) Reinforcing steel shall conform to Grade 400 in CAN/CSA-G30.18-M, "Billet-Steel Bars for Concrete Reinforcement".

9.39.1.4. Slab Construction

(1) Concrete shall be cast against form work in accordance with CSA A23.1, "Concrete Materials and Methods of Concrete Construction".

(2) The slab shall be not less than 125 mm thick.

(3) The slab shall be reinforced with 10M bars spaced not more than 200 mm o.c. in each direction, with 30 mm clear cover from the bottom of the slab to the first layer of bars, and the second layer of bars laid directly on top of the lower layer in the opposite direction.

(4) The slab shall bear not less than 75 mm on the supporting *foundation* walls and be anchored to the walls with 600 mm × 600 mm 10M bent dowels spaced at not more than 600 mm o.c.

(5) Exposed slabs shall be sloped to effectively shed water away from the exterior wall.

Table A-1
Maximum Spans for Floor Joists – General Cases[1]
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			With Strapping[2]			With Bridging			With Strapping[2] and Bridging		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			305	406	610	305	406	610	305	406	610
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.13	1.97	1.73	2.19	1.99	1.73	2.19	1.99	1.73
		38 × 140	3.23	3.07	2.73	3.44	3.12	2.73	3.44	3.12	2.73
		38 × 184	3.88	3.69	3.51	4.18	3.92	3.59	4.37	4.07	3.59
		38 × 235	4.57	4.34	4.13	4.86	4.57	4.29	5.05	4.70	4.39
		38 × 286	5.21	4.95	4.71	5.49	5.16	4.85	5.66	5.28	4.92
	No. 1 and No. 2	38 × 89	2.00	1.85	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 × 140	3.09	2.91	2.62	3.29	2.99	2.62	3.29	2.99	2.62
		38 × 184	3.71	3.53	3.36	4.00	3.76	3.44	4.19	3.90	3.44
		38 × 235	4.38	4.16	3.96	4.66	4.38	4.11	4.84	4.51	4.20
		38 × 286	4.99	4.75	4.52	5.26	4.94	4.65	5.43	5.06	4.72
	No. 3	38 × 89	1.90	1.69	1.38	1.95	1.69	1.38	1.95	1.69	1.38
		38 × 140	2.78	2.41	1.97	2.78	2.41	1.97	2.78	2.41	1.97
		38 × 184	3.38	2.93	2.39	3.38	2.93	2.39	3.38	2.93	2.39
		38 × 235	4.14	3.58	2.93	4.14	3.58	2.93	4.14	3.58	2.93
		38 × 286	4.80	4.16	3.39	4.80	4.16	3.39	4.80	4.16	3.39
	Construction	38 × 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 × 89	1.81	1.63	1.33	1.88	1.63	1.33	1.88	1.63	1.33
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.08	1.93	1.71	2.16	1.96	1.71	2.16	1.96	1.71
		38 × 140	3.18	3.03	2.69	3.39	3.08	2.69	3.39	3.08	2.69
		38 × 184	3.82	3.64	3.46	4.12	3.87	3.54	4.31	4.02	3.54
		38 × 235	4.50	4.28	4.08	4.80	4.51	4.23	4.98	4.64	4.33
		38 × 286	5.14	4.89	4.65	5.42	5.09	4.78	5.59	5.21	4.86
	No. 1 and No. 2	38 × 89	2.00	1.85	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 × 140	3.09	2.91	2.62	3.29	2.99	2.62	3.29	2.99	2.62
		38 × 184	3.71	3.53	3.36	4.00	3.76	3.44	4.19	3.90	3.44
		38 × 235	4.38	4.16	3.96	4.66	4.38	4.11	4.84	4.51	4.20
		38 × 286	4.99	4.75	4.52	5.26	4.94	4.65	5.43	5.06	4.72
	No. 3	38 × 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
		38 × 140	2.99	2.78	2.43	3.19	2.90	2.43	3.19	2.90	2.43
		38 × 184	3.60	3.42	2.95	3.88	3.61	2.95	4.06	3.61	2.95
		38 × 235	4.24	4.03	3.61	4.51	4.24	3.61	4.68	4.37	3.61
		38 × 286	4.84	4.60	4.19	5.10	4.79	4.19	5.26	4.90	4.19
	Construction	38 × 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 × 89	1.81	1.68	1.39	1.96	1.71	1.39	1.96	1.71	1.39
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-1 (Cont'd)
Maximum Spans for Floor Joists – General Cases(1)
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			With Strapping(2)			With Bridging			With Strapping(2) and Bridging		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			305	406	610	305	406	610	305	406	610
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	1.95	1.81	1.64	2.06	1.87	1.64	2.06	1.87	1.64
		38 × 140	3.05	2.85	2.57	3.24	2.95	2.57	3.24	2.95	2.57
		38 × 184	3.66	3.48	3.31	3.94	3.70	3.38	4.12	3.84	3.38
		38 × 235	4.31	4.10	3.90	4.59	4.31	4.05	4.76	4.44	4.14
		38 × 286	4.91	4.67	4.45	5.18	4.87	4.57	5.34	4.98	4.64
	No. 1 and No. 2	38 × 89	1.86	1.72	1.58	1.99	1.81	1.58	1.99	1.81	1.58
		38 × 140	2.92	2.71	2.49	3.14	2.85	2.49	3.14	2.85	2.49
		38 × 184	3.54	3.36	3.20	3.81	3.58	3.27	3.99	3.72	3.27
		38 × 235	4.17	3.96	3.77	4.44	4.17	3.92	4.60	4.29	4.00
		38 × 286	4.75	4.52	4.30	5.01	4.71	4.42	5.17	4.82	4.49
	No. 3	38 × 89	1.81	1.68	1.55	1.96	1.78	1.55	1.96	1.78	1.55
		38 × 140	2.84	2.64	2.43	3.08	2.80	2.43	3.08	2.80	2.43
		38 × 184	3.47	3.30	2.95	3.74	3.52	2.95	3.92	3.61	2.95
		38 × 235	4.09	3.89	3.61	4.36	4.09	3.61	4.52	4.22	3.61
		38 × 286	4.67	4.44	4.19	4.92	4.62	4.19	5.08	4.73	4.19
	Construction	38 × 89	1.81	1.68	1.55	1.96	1.78	1.55	1.96	1.78	1.55
	Standard	38 × 89	1.70	1.58	1.44	1.88	1.71	1.44	1.88	1.71	1.44
Northern Species (includes any Canadian Species covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	1.65	1.53	1.42	1.84	1.68	1.46	1.84	1.68	1.46
		38 × 140	2.59	2.41	2.24	2.90	2.63	2.30	2.90	2.63	2.30
		38 × 184	3.27	3.11	2.94	3.52	3.31	3.03	3.69	3.44	3.03
		38 × 235	3.85	3.66	3.48	4.10	3.85	3.62	4.26	3.97	3.70
		38 × 286	4.39	4.18	3.97	4.63	4.35	4.09	4.78	4.45	4.15
	No. 1 and No. 2	38 × 89	1.59	1.48	1.37	1.80	1.64	1.43	1.80	1.64	1.43
		38 × 140	2.51	2.33	2.16	2.83	2.57	2.25	2.83	2.57	2.25
		38 × 184	3.19	3.04	2.84	3.44	3.23	2.96	3.60	3.36	2.96
		38 × 235	3.76	3.58	3.41	4.01	3.77	3.54	4.16	3.88	3.62
		38 × 286	4.29	4.08	3.88	4.53	4.25	4.00	4.67	4.35	4.06
	No. 3	38 × 89	1.54	1.43	1.32	1.74	1.57	1.36	1.76	1.60	1.36
		38 × 140	2.42	2.24	1.94	2.74	2.38	1.94	2.75	2.38	1.94
		38 × 184	3.12	2.90	2.37	3.35	2.90	2.37	3.35	2.90	2.37
		38 × 235	3.67	3.49	2.89	3.91	3.54	2.89	4.06	3.54	2.89
		38 × 286	4.19	3.98	3.36	4.42	4.11	3.36	4.55	4.11	3.36
	Construction	38 × 89	1.54	1.43	1.32	1.74	1.57	1.40	1.76	1.60	1.40
	Standard	38 × 89	1.48	1.37	1.15	1.63	1.41	1.15	1.63	1.41	1.15
Column 1	2	3	4	5	6	7	8	9	10	11	12

Notes to Table A-1:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floor does not exceed that specified for residential areas as described in Table 4.1.5.3.

(2) See Sentence 9.23.9.4.(5) for alternatives to strapping.

Table A-2
Maximum Spans for Floor Joists – Special Cases(1)
Forming Part of Sentence 9.23.4.2.(1) and 9.23.4.4.(2)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			Joists with Ceilings Attached to Wood Furring						Joists with Concrete Topping		
			Without Bridging			With Bridging			With or Without Bridging(2)		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			305	406	610	305	406	610	305	406	610
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.19	1.99	1.73	2.19	1.99	1.73	2.19	1.99	1.73
		38 × 140	3.44	3.12	2.73	3.44	3.12	2.73	3.44	3.12	2.73
		38 × 184	4.24	3.99	3.59	4.52	4.11	3.59	4.52	4.11	3.59
		38 × 235	4.98	4.69	4.29	5.47	5.20	4.58	5.77	5.24	4.58
		38 × 286	5.67	5.34	4.88	6.19	5.89	5.54	6.83	6.37	5.58
	No. 1 and No. 2	38 × 89	2.09	1.90	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 × 140	3.29	2.99	2.62	3.29	2.99	2.62	3.29	2.99	2.55
		38 × 184	4.06	3.83	3.44	4.33	3.93	3.44	4.33	3.81	3.11
		38 × 235	4.78	4.50	4.11	5.24	4.98	4.31	5.37	4.65	3.80
		38 × 286	5.44	5.12	4.68	5.93	5.64	5.00	6.24	5.40	4.41
	No. 3	38 × 89	1.95	1.69	1.38	1.95	1.69	1.38	1.72	1.49	1.21
		38 × 140	2.78	2.41	1.97	2.78	2.41	1.97	2.45	2.12	1.73
		38 × 184	3.38	2.93	2.39	3.38	2.93	2.39	2.98	2.58	2.11
		38 × 235	4.14	3.58	2.93	4.14	3.58	2.93	3.65	3.16	2.58
		38 × 286	4.80	4.16	3.39	4.80	4.16	3.39	4.23	3.66	2.99
	Construction	38 × 89	2.03	1.84	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 × 89	1.88	1.63	1.33	1.88	1.63	1.33	1.66	1.44	1.17
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.16	1.96	1.71	2.16	1.96	1.71	2.16	1.96	1.71
		38 × 140	3.39	3.08	2.69	3.39	3.08	2.69	3.39	3.08	2.69
		38 × 184	4.18	3.94	3.54	4.46	4.05	3.54	4.46	4.05	3.54
		38 × 235	4.92	4.63	4.23	5.39	5.13	4.52	5.69	5.17	4.52
		38 × 286	5.60	5.27	4.82	6.10	5.81	5.47	6.74	6.28	5.50
	No. 1 and No. 2	38 × 89	2.09	1.90	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 × 140	3.29	2.99	2.62	3.29	2.99	2.62	3.29	2.99	2.62
		38 × 184	4.06	3.83	3.44	4.33	3.93	3.44	4.33	3.93	3.26
		38 × 235	4.78	4.50	4.11	5.24	4.98	4.39	5.53	4.88	3.99
		38 × 286	5.44	5.12	4.68	5.93	5.64	5.25	6.54	5.66	4.63
	No. 3	38 × 89	2.03	1.84	1.61	2.03	1.84	1.61	2.03	1.83	1.50
		38 × 140	3.19	2.90	2.43	3.19	2.90	2.43	3.02	2.62	2.14
		38 × 184	3.94	3.61	2.95	4.17	3.61	2.95	3.68	3.18	2.60
		38 × 235	4.63	4.36	3.61	5.08	4.42	3.61	4.50	3.89	3.18
		38 × 286	5.27	4.96	4.19	5.74	5.13	4.19	5.22	4.52	3.69
	Construction	38 × 89	2.03	1.84	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 × 89	1.96	1.71	1.39	1.96	1.71	1.39	1.74	1.50	1.23
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-2 (Cont'd)
Maximum Spans for Floor Joists – Special Cases(1)
Forming Part of Sentence 9.23.4.2.(1) and 9.23.4.4.(2)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			Joists with Ceilings Attached to Wood Furring						Joists with Concrete Topping		
			Without Bridging			With Bridging			With or Without Bridging(2)		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			305	406	610	305	406	610	305	406	610
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	2.06	1.87	1.64	2.06	1.87	1.64	2.06	1.87	1.64
		38 × 140	3.24	2.95	2.57	3.24	2.95	2.57	3.24	2.95	2.57
		38 × 184	4.00	3.77	3.38	4.26	3.87	3.38	4.26	3.87	3.38
		38 × 235	4.70	4.43	4.05	5.16	4.91	4.32	5.45	4.95	4.32
		38 × 286	5.35	5.04	4.61	5.84	5.55	5.23	6.45	6.01	5.26
	No. 1 and No. 2	38 × 89	1.99	1.81	1.58	1.99	1.81	1.58	1.99	1.81	1.58
		38 × 140	3.14	2.85	2.49	3.14	2.85	2.49	3.14	2.85	2.49
		38 × 184	3.87	3.64	3.27	4.12	3.75	3.27	4.12	3.75	3.27
		38 × 235	4.55	4.28	3.91	4.99	4.75	4.18	5.27	4.79	4.13
		38 × 286	5.18	4.88	4.46	5.65	5.37	5.06	6.23	5.81	4.79
	No. 3	38 × 89	1.96	1.78	1.55	1.96	1.78	1.55	1.96	1.78	1.50
		38 × 140	3.08	2.80	2.43	3.08	2.80	2.43	3.02	2.62	2.14
		38 × 184	3.80	3.58	2.95	4.05	3.61	2.95	3.68	3.18	2.60
		38 × 235	4.47	4.21	3.61	4.90	4.42	3.61	4.50	3.89	3.18
		38 × 286	5.09	4.79	4.19	5.55	5.13	4.19	5.22	4.52	3.69
	Construction	38 × 89	1.96	1.78	1.55	1.96	1.78	1.55	1.96	1.78	1.55
	Standard	38 × 89	1.88	1.71	1.44	1.88	1.71	1.44	1.80	1.56	1.27
Northern Species (includes any Canadian Species covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	1.84	1.68	1.46	1.84	1.68	1.46	1.84	1.68	1.46
		38 × 140	2.90	2.63	2.30	2.90	2.63	2.30	2.90	2.63	2.30
		38 × 184	3.58	3.37	3.03	3.81	3.46	3.03	3.81	3.46	3.03
		38 × 235	4.20	3.96	3.62	4.61	4.39	3.86	4.87	4.42	3.86
		38 × 286	4.79	4.51	4.12	5.22	4.96	4.68	5.76	5.37	4.54
	No. 1 and No. 2	38 × 89	1.80	1.64	1.43	1.80	1.64	1.43	1.80	1.64	1.43
		38 × 140	2.83	2.57	2.25	2.83	2.57	2.25	2.83	2.57	2.23
		38 × 184	3.50	3.29	2.96	3.72	3.38	2.96	3.72	3.32	2.71
		38 × 235	4.11	3.87	3.54	4.51	4.29	3.76	4.69	4.06	3.31
		38 × 286	4.68	4.40	4.03	5.10	4.85	4.36	5.44	4.71	3.84
	No. 3	38 × 89	1.76	1.60	1.36	1.76	1.60	1.36	1.70	1.47	1.20
		38 × 140	2.75	2.38	1.94	2.75	2.38	1.94	2.42	2.10	1.71
		38 × 184	3.35	2.90	2.37	3.35	2.90	2.37	2.95	2.55	2.08
		38 × 235	4.01	3.54	2.89	4.09	3.54	2.89	3.61	3.12	2.55
		38 × 286	4.56	4.11	3.36	4.75	4.11	3.36	4.18	3.62	2.96
	Construction	38 × 89	1.76	1.60	1.40	1.76	1.60	1.40	1.76	1.60	1.37
	Standard	38 × 89	1.63	1.41	1.15	1.63	1.41	1.15	1.44	1.25	1.02
Column 1	2	3	4	5	6	7	8	9	10	11	12

Notes to Table A-2:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floor does not exceed that specified for residential areas as described in Table 4.1.5.3.

(2) No bridging is assumed for spans for floor joists with concrete topping.

Table A-3
Maximum Spans for Ceiling Joists – Attic Not Accessible by a Stairway
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m		
			Joist Spacing, mm		
			305	406	610
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	3.41	3.10	2.71
		38 × 140	5.37	4.88	4.26
		38 × 184	7.05	6.41	5.60
		38 × 235	9.01	8.18	7.15
		38 × 286	10.96	9.96	8.70
	No. 1 and No. 2	38 × 89	3.27	2.97	2.59
		38 × 140	5.14	4.67	4.08
		38 × 184	6.76	6.14	5.36
		38 × 235	8.63	7.84	6.85
		38 × 286	10.50	9.54	8.34
	No. 3	38 × 89	3.17	2.88	2.42
		38 × 140	4.89	4.23	3.46
		38 × 184	5.95	5.15	4.20
		38 × 235	7.27	6.30	5.14
		38 × 286	8.44	7.31	5.97
	Construction	38 × 89	3.17	2.88	2.51
	Standard	38 × 89	3.06	2.78	2.34
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	3.36	3.06	2.67
		38 × 140	5.29	4.81	4.20
		38 × 184	6.96	6.32	5.52
		38 × 235	8.88	8.07	7.05
		38 × 286	10.81	9.82	8.58
	No. 1 and No. 2	38 × 89	3.27	2.97	2.59
		38 × 140	5.14	4.67	4.08
		38 × 184	6.76	6.14	5.36
		38 × 235	8.63	7.84	6.85
		38 × 286	10.50	9.54	8.34
	No. 3	38 × 89	3.17	2.88	2.51
		38 × 140	4.98	4.53	3.95
		38 × 184	6.55	5.95	5.19
		38 × 235	8.36	7.60	6.34
		38 × 286	10.18	9.01	7.36
	Construction	38 × 89	3.17	2.88	2.50
	Standard	38 × 89	3.06	2.78	2.43
Column 1	2	3	4	5	6

Table A-3 (Cont'd)
Maximum Spans for Ceiling Joists – Attic Not Accessible by a Stairway
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m		
			Joist Spacing, mm		
			305	406	610
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	3.22	2.92	2.55
		38 × 140	5.06	4.60	4.02
		38 × 184	6.65	6.05	5.28
		38 × 235	8.50	7.72	6.74
		38 × 286	10.34	9.40	8.21
	No. 1 and No. 2	38 × 89	3.11	2.83	2.47
		38 × 140	4.90	4.45	3.89
		38 × 184	6.44	5.85	5.11
		38 × 235	8.22	7.47	6.52
		38 × 286	10.00	9.09	7.94
	No. 3	38 × 89	3.06	2.78	2.43
		38 × 140	4.81	4.37	3.82
		38 × 184	6.32	5.74	5.02
		38 × 235	8.07	7.33	6.34
		38 × 286	9.82	8.93	7.36
	Construction	38 × 89	3.06	2.78	2.43
	Standard	38 × 89	2.94	2.67	2.33
Northern Species (includes any Canadian Species covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	2.88	2.61	2.28
		38 × 140	4.53	4.11	3.59
		38 × 184	5.95	5.40	4.72
		38 × 235	7.60	6.90	6.03
		38 × 286	9.25	8.40	7.34
	No. 1 and No. 2	38 × 89	2.81	2.55	2.23
		38 × 140	4.42	4.02	3.51
		38 × 184	5.81	5.28	4.61
		38 × 235	7.42	6.74	5.89
		38 × 286	9.03	8.21	7.17
	No. 3	38 × 89	2.74	2.49	2.18
		38 × 140	4.31	3.92	3.42
		38 × 184	5.67	5.09	4.16
		38 × 235	7.19	6.23	5.08
		38 × 286	8.34	7.23	5.90
	Construction	38 × 89	2.74	2.49	2.18
	Standard	38 × 89	2.67	2.43	2.03
Column 1	2	3	4	5	6

Table A-4
Maximum Spans for Roof Joists – Specified Roof Snow Loads 1.0 to 2.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			Specified Snow Load, kPa								
			1.0			1.5			2.0		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			305	406	610	305	406	610	305	406	610
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.71	2.46	2.15	2.37	2.15	1.88	2.15	1.95	1.71
		38 × 140	4.26	3.87	3.38	3.72	3.38	2.95	3.38	3.07	2.68
		38 × 184	5.60	5.09	4.44	4.89	4.44	3.88	4.44	4.04	3.53
		38 × 235	7.15	6.49	5.67	6.24	5.67	4.96	5.67	5.15	4.50
		38 × 286	8.70	7.90	6.91	7.60	6.91	6.03	6.91	6.27	5.48
	No. 1 and No. 2	38 × 89	2.59	2.36	2.06	2.27	2.06	1.80	2.06	1.87	1.63
		38 × 140	4.08	3.71	3.24	3.57	3.24	2.83	3.24	2.94	2.57
		38 × 184	5.36	4.87	4.26	4.69	4.26	3.72	4.26	3.87	3.38
		38 × 235	6.85	6.22	5.44	5.98	5.44	4.74	5.44	4.94	4.22
		38 × 286	8.34	7.57	6.40	7.28	6.62	5.50	6.62	6.00	4.90
	No. 3	38 × 89	2.49	2.16	1.76	2.14	1.85	1.51	1.91	1.65	1.35
		38 × 140	3.56	3.08	2.51	3.06	2.65	2.16	2.72	2.36	1.92
		38 × 184	4.33	3.75	3.06	3.72	3.22	2.63	3.31	2.87	2.34
		38 × 235	5.29	4.58	3.74	4.55	3.94	3.22	4.05	3.51	2.86
		38 × 286	6.14	5.32	4.34	5.28	4.57	3.73	4.70	4.07	3.32
	Construction	38 × 89	2.51	2.28	1.99	2.20	1.99	1.74	1.99	1.81	1.58
	Standard	38 × 89	2.41	2.08	1.70	2.07	1.79	1.46	1.84	1.60	1.30
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.67	2.43	2.12	2.33	2.12	1.85	2.12	1.93	1.68
		38 × 140	4.20	3.82	3.33	3.67	3.33	2.91	3.33	3.03	2.65
		38 × 184	5.52	5.02	4.38	4.82	4.38	3.83	4.38	3.98	3.48
		38 × 235	7.05	6.41	5.60	6.16	5.60	4.89	5.60	5.09	4.44
		38 × 286	8.58	7.80	6.81	7.50	6.81	5.95	6.81	6.19	5.41
	No. 1 and No. 2	38 × 89	2.59	2.36	2.06	2.27	2.06	1.80	2.06	1.87	1.63
		38 × 140	4.08	3.71	3.24	3.57	3.24	2.83	3.24	2.94	2.57
		38 × 184	5.36	4.87	4.26	4.69	4.26	3.72	4.26	3.87	3.38
		38 × 235	6.85	6.22	5.44	5.98	5.44	4.75	5.44	4.94	4.32
		38 × 286	8.34	7.57	6.62	7.28	6.62	5.77	6.62	6.01	5.25
	No. 3	38 × 89	2.51	2.28	1.99	2.20	1.99	1.74	1.99	1.81	1.58
		38 × 140	3.95	3.59	3.10	3.45	3.14	2.67	3.14	2.85	2.37
		38 × 184	5.20	4.62	3.77	4.54	3.97	3.24	4.09	3.54	2.89
		38 × 235	6.53	5.65	4.61	5.61	4.86	3.97	5.00	4.33	3.53
		38 × 286	7.57	6.56	5.35	6.51	5.64	4.60	5.80	5.02	4.10
	Construction	38 × 89	2.51	2.28	1.99	2.20	1.99	1.74	1.99	1.81	1.58
	Standard	38 × 89	2.43	2.18	1.78	2.12	1.88	1.53	1.93	1.67	1.36
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-4 (Cont'd)
Maximum Spans for Roof Joists – Specified Roof Snow Loads 1.0 to 2.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			Specified Snow Load, kPa								
			1.0			1.5			2.0		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			305	406	610	305	406	610	305	406	610
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	2.55	2.32	2.03	2.23	2.03	1.77	2.03	1.84	1.61
		38 × 140	4.02	3.65	3.19	3.51	3.19	2.79	3.19	2.90	2.53
		38 × 184	5.28	4.80	4.19	4.61	4.19	3.66	4.19	3.81	3.33
		38 × 235	6.74	6.13	5.35	5.89	5.35	4.68	5.35	4.86	4.25
		38 × 286	8.21	7.46	6.52	7.17	6.52	5.69	6.52	5.92	5.17
	No. 1 and No. 2	38 × 89	2.47	2.24	1.96	2.16	1.96	1.71	1.96	1.78	1.56
		38 × 140	3.89	3.53	3.08	3.40	3.08	2.69	3.08	2.80	2.45
		38 × 184	5.11	4.64	4.05	4.46	4.05	3.54	4.05	3.68	3.22
		38 × 235	6.52	5.93	5.18	5.70	5.18	4.52	5.18	4.70	4.11
		38 × 286	7.94	7.21	6.30	6.94	6.30	5.50	6.30	5.73	5.00
	No. 3	38 × 89	2.43	2.20	1.93	2.12	1.93	1.68	1.93	1.75	1.53
		38 × 140	3.82	3.47	3.03	3.33	3.03	2.65	3.03	2.75	2.37
		38 × 184	5.02	4.56	3.77	4.38	3.97	3.24	3.98	3.54	2.89
		38 × 235	6.41	5.65	4.61	5.60	4.86	3.97	5.00	4.33	3.53
		38 × 286	7.57	6.56	5.35	6.51	5.64	4.60	5.80	5.02	4.10
	Construction	38 × 89	2.43	2.20	1.93	2.12	1.93	1.68	1.93	1.75	1.53
	Standard	38 × 89	2.33	2.12	1.85	2.04	1.85	1.59	1.85	1.68	1.41
Northern Species (includes any Canadian Species covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	2.28	2.07	1.81	1.99	1.81	1.58	1.81	1.65	1.44
		38 × 140	3.59	3.26	2.85	3.14	2.85	2.49	2.85	2.59	2.26
		38 × 184	4.72	4.29	3.75	4.12	3.75	3.27	3.75	3.40	2.97
		38 × 235	6.03	5.48	4.79	5.27	4.79	4.18	4.79	4.35	3.80
		38 × 286	7.34	6.67	5.82	6.41	5.82	5.09	5.82	5.29	4.62
	No. 1 and No. 2	38 × 89	2.23	2.03	1.77	1.95	1.77	1.55	1.77	1.61	1.41
		38 × 140	3.51	3.19	2.79	3.07	2.79	2.43	2.79	2.53	2.21
		38 × 184	4.61	4.19	3.66	4.03	3.66	3.20	3.66	3.33	2.91
		38 × 235	5.89	5.35	4.68	5.15	4.68	4.09	4.68	4.25	3.68
		38 × 286	7.17	6.52	5.58	6.26	5.69	4.80	5.69	5.17	4.27
	No. 3	38 × 89	2.18	1.98	1.73	1.90	1.73	1.50	1.73	1.57	1.33
		38 × 140	3.42	3.05	2.49	2.99	2.62	2.14	2.69	2.33	1.90
		38 × 184	4.28	3.71	3.03	3.68	3.19	2.60	3.28	2.84	2.32
		38 × 235	5.23	4.53	3.70	4.50	3.90	3.18	4.01	3.47	2.83
		38 × 286	6.07	5.26	4.29	5.22	4.52	3.69	4.65	4.03	3.29
	Construction	38 × 89	2.18	1.98	1.73	1.90	1.73	1.51	1.73	1.57	1.37
	Standard	38 × 89	2.09	1.81	1.48	1.80	1.56	1.27	1.60	1.38	1.13
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-5
Maximum Spans for Roof Joists – Specified Roof Snow Loads 2.5 and 3.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m					
			Specified Snow Load, kPa					
			2.5			3.0		
			Joist Spacing, mm			Joist Spacing, mm		
			305	406	610	305	406	610
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	1.99	1.81	1.58	1.88	1.71	1.49
		38 × 140	3.14	2.85	2.49	2.95	2.68	2.34
		38 × 184	4.12	3.75	3.27	3.88	3.53	3.08
		38 × 235	5.27	4.79	4.18	4.96	4.50	3.93
		38 × 286	6.41	5.82	5.09	6.03	5.48	4.79
	No. 1 and No. 2	38 × 89	1.91	1.74	1.52	1.80	1.63	1.43
		38 × 140	3.01	2.73	2.39	2.83	2.57	2.25
		38 × 184	3.95	3.59	3.14	3.72	3.38	2.90
		38 × 235	5.05	4.59	3.84	4.75	4.32	3.55
		38 × 286	6.14	5.46	4.46	5.78	5.05	4.12
	No. 3	38 × 89	1.74	1.50	1.23	1.60	1.39	1.13
		38 × 140	2.48	2.15	1.75	2.29	1.98	1.62
		38 × 184	3.01	2.61	2.13	2.79	2.41	1.97
		38 × 235	3.69	3.19	2.61	3.41	2.95	2.41
		38 × 286	4.28	3.70	3.03	3.95	3.42	2.79
	Construction	38 × 89	1.85	1.68	1.47	1.74	1.58	1.38
	Standard	38 × 89	1.68	1.45	1.19	1.55	1.34	1.10
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	1.97	1.79	1.56	1.85	1.68	1.47
		38 × 140	3.10	2.81	2.46	2.91	2.65	2.31
		38 × 184	4.07	3.70	3.23	3.83	3.48	3.04
		38 × 235	5.20	4.72	4.12	4.89	4.44	3.88
		38 × 286	6.32	5.75	5.02	5.95	5.41	4.72
	No. 1 and No. 2	38 × 89	1.91	1.74	1.52	1.80	1.63	1.43
		38 × 140	3.01	2.73	2.39	2.83	2.57	2.25
		38 × 184	3.95	3.59	3.14	3.72	3.38	2.95
		38 × 235	5.05	4.59	4.01	4.75	4.32	3.72
		38 × 286	6.14	5.58	4.68	5.78	5.25	4.32
	No. 3	38 × 89	1.85	1.68	1.47	1.74	1.58	1.38
		38 × 140	2.91	2.65	2.16	2.74	2.45	2.00
		38 × 184	3.72	3.22	2.63	3.44	2.98	2.43
		38 × 235	4.55	3.94	3.22	4.20	3.64	2.97
		38 × 286	5.28	4.57	3.73	4.88	4.22	3.45
	Construction	38 × 89	1.85	1.68	1.47	1.74	1.58	1.38
	Standard	38 × 89	1.76	1.52	1.24	1.62	1.40	1.15
Column 1	2	3	4	5	6	7	8	9

Table A-5 (Cont'd)
Maximum Spans for Roof Joists – Specified Roof Snow Loads 2.5 and 3.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m					
			Specified Snow Load, kPa					
			2.5			3.0		
			Joist Spacing, mm			Joist Spacing, mm		
			305	406	610	305	406	610
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	1.88	1.71	1.49	1.77	1.61	1.41
		38 × 140	2.96	2.69	2.35	2.79	2.53	2.21
		38 × 184	3.89	3.54	3.09	3.66	3.33	2.91
		38 × 235	4.97	4.52	3.94	4.68	4.25	3.71
		38 × 286	6.05	5.50	4.80	5.69	5.17	4.52
	No. 1 and No. 2	38 × 89	1.82	1.65	1.44	1.71	1.56	1.36
		38 × 140	2.86	2.60	2.27	2.69	2.45	2.14
		38 × 184	3.76	3.42	2.99	3.54	3.22	2.81
		38 × 235	4.81	4.37	3.82	4.52	4.11	3.59
		38 × 286	5.85	5.31	4.64	5.50	5.00	4.37
	No. 3	38 × 89	1.79	1.62	1.42	1.68	1.53	1.34
		38 × 140	2.81	2.56	2.16	2.65	2.40	2.005
		38 × 184	3.70	3.22	2.63	3.44	2.98	2.43
		38 × 235	4.55	3.94	3.22	4.20	3.64	2.97
		38 × 286	5.28	4.57	3.73	4.88	4.22	3.45
	Construction	38 × 89	1.79	1.62	1.42	1.68	1.53	1.34
	Standard	38 × 89	1.72	1.56	1.29	1.62	1.46	1.19
Northern Species (includes any Canadian Species covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	1.68	1.53	1.34	1.58	1.44	1.26
		38 × 140	2.65	2.40	2.10	2.49	2.26	1.98
		38 × 184	3.48	3.16	2.76	3.27	2.97	2.60
		38 × 235	4.44	4.04	3.53	4.18	3.80	3.32
		38 × 286	5.41	4.91	4.29	5.09	4.62	4.04
	No. 1 and No. 2	38 × 89	1.64	1.49	1.31	1.55	1.41	1.23
		38 × 140	2.59	2.35	2.05	2.43	2.21	1.93
		38 × 184	3.40	3.09	2.70	3.20	2.91	2.53
		38 × 235	4.34	3.94	3.35	4.09	3.71	3.10
		38 × 286	5.28	4.76	3.89	4.97	4.40	3.59
	No. 3	38 × 89	1.60	1.46	1.21	1.51	1.37	1.12
		38 × 140	2.45	2.12	1.73	2.26	1.96	1.60
		38 × 184	2.98	2.58	2.11	2.76	2.39	1.95
		38 × 235	3.65	3.16	2.58	3.37	2.92	2.38
		38 × 286	4.23	3.66	2.99	3.91	3.39	2.76
	Construction	38 × 89	1.60	1.46	1.27	1.51	1.37	1.20
	Standard	38 × 89	1.46	1.26	1.03	1.34	1.16	0.95
Column 1	2	3	4	5	6	7	8	9

Table A-6
Maximum Spans for Roof Rafters – Specified Roof Snow Loads 1.0 to 2.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Rafter Size, mm	Maximum Span, m								
			Specified Snow Load, kPa								
			1.0			1.5			2.0		
			Rafter Spacing, mm			Rafter Spacing, mm			Rafter Spacing, mm		
			305	406	610	305	406	610	305	406	610
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	3.41	3.10	2.71	2.98	2.71	2.37	2.71	2.46	2.15
		38 × 140	5.37	4.88	4.26	4.69	4.26	3.72	4.26	3.87	3.38
		38 × 184	7.05	6.41	5.60	6.16	5.60	4.89	5.60	5.09	4.44
		38 × 235	9.01	8.18	7.15	7.87	7.15	6.24	7.15	6.49	5.62
		38 × 286	10.96	9.96	8.70	9.58	8.70	7.40	8.70	7.90	6.52
	No. 1 and No. 2	38 × 89	3.27	2.97	2.59	2.86	2.59	2.27	2.59	2.36	2.06
		38 × 140	5.14	4.67	3.95	4.49	4.08	3.34	4.08	3.60	2.94
		38 × 184	6.76	5.88	4.80	5.74	4.97	4.06	5.06	4.38	3.58
		38 × 235	8.30	7.19	5.87	7.02	6.08	4.96	6.19	5.36	4.38
		38 × 286	9.63	8.34	6.81	8.14	7.05	5.76	7.18	6.22	5.08
	No. 3	38 × 89	2.65	2.30	1.87	2.24	1.94	1.58	1.98	1.71	1.40
		38 × 140	3.78	3.28	2.68	3.20	2.77	2.26	2.82	2.44	1.99
		38 × 184	4.61	3.99	3.26	3.89	3.37	2.75	3.43	2.97	2.43
		38 × 235	5.63	4.88	3.98	4.76	4.12	3.37	4.20	3.64	2.97
		38 × 286	6.53	5.66	4.62	5.52	4.78	3.91	4.87	4.22	3.44
	Construction	38 × 89	3.17	2.88	2.42	2.77	2.50	2.04	2.51	2.21	1.80
	Standard	38 × 89	2.56	2.22	1.81	2.17	1.88	1.53	1.91	1.65	1.35
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	3.36	3.06	2.67	2.94	2.67	2.33	2.67	2.43	2.12
		38 × 140	5.29	4.81	4.20	4.62	4.20	3.67	4.20	3.82	3.33
		38 × 184	6.96	6.32	5.52	6.08	5.52	4.82	5.52	5.02	4.38
		38 × 235	8.88	8.07	7.05	7.76	7.05	6.16	7.05	6.41	5.54
		38 × 286	10.81	9.82	8.58	9.45	8.58	7.28	8.58	7.80	6.42
	No. 1 and No. 2	38 × 89	3.27	2.97	2.59	2.86	2.59	2.27	2.59	2.36	2.06
		38 × 140	5.14	4.67	4.08	4.49	4.08	3.50	4.08	3.71	3.08
		38 × 184	6.76	6.14	5.04	5.90	5.21	4.26	5.31	4.60	3.75
		38 × 235	8.63	7.54	6.16	7.36	6.37	5.20	6.49	5.62	4.59
		38 × 286	10.11	8.75	7.15	8.54	7.40	6.04	7.53	6.52	5.33
	No. 3	38 × 89	3.17	2.83	2.31	2.76	2.39	1.95	2.44	2.11	1.72
		38 × 140	4.67	4.04	3.30	3.95	3.42	2.79	3.48	3.01	2.46
		38 × 184	5.68	4.92	4.02	4.80	4.16	3.40	4.23	3.67	2.99
		38 × 235	6.95	6.02	4.91	5.87	5.08	4.15	5.18	4.48	3.66
		38 × 286	8.06	6.98	5.70	6.81	5.90	4.82	6.01	5.20	4.25
	Construction	38 × 89	3.17	2.88	2.51	2.77	2.51	2.14	2.51	2.28	1.89
	Standard	38 × 89	2.68	2.32	1.90	2.27	1.96	1.60	2.00	1.73	1.41
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-6 (Cont'd)
Maximum Spans for Roof Rafters – Specified Roof Snow Loads 1.0 to 2.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Rafter Size, mm	Maximum Span, m								
			Specified Snow Load, kPa								
			1.0			1.5			2.0		
			Rafter Spacing, mm			Rafter Spacing, mm			Rafter Spacing, mm		
			305	406	610	305	406	610	305	406	610
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	3.22	2.92	2.55	2.81	2.55	2.23	2.55	2.32	2.03
		38 × 140	5.06	4.60	4.02	4.42	4.02	3.51	4.02	3.65	3.19
		38 × 184	6.65	6.05	5.28	5.81	5.28	4.61	5.28	4.80	4.19
		38 × 235	8.50	7.72	6.74	7.42	6.74	5.89	6.74	6.13	5.35
		38 × 286	10.34	9.40	8.21	9.03	8.21	7.17	8.21	7.46	6.52
	No. 1 and No. 2	38 × 89	3.11	2.83	2.47	2.72	2.47	2.16	2.47	2.24	1.96
		38 × 140	4.90	4.45	3.89	4.28	3.89	3.40	3.89	3.53	3.08
		38 × 184	6.44	5.85	5.11	5.62	5.11	4.41	5.11	4.64	3.89
		38 × 235	8.22	7.47	6.38	7.18	6.52	5.39	6.52	5.82	4.75
		38 × 286	10.00	9.06	7.40	8.74	7.66	6.25	7.80	6.76	5.52
	No. 3	38 × 89	3.06	2.78	2.31	2.67	2.39	1.95	2.43	2.11	1.72
		38 × 140	4.67	4.04	3.30	3.95	3.42	2.79	3.48	3.01	2.46
		38 × 184	5.68	4.92	4.02	4.80	4.16	3.40	4.23	3.67	2.99
		38 × 235	6.95	6.02	4.91	5.87	5.08	4.15	5.18	4.48	3.66
		38 × 286	8.06	6.98	5.70	6.81	5.90	4.82	6.01	5.20	4.25
	Construction	38 × 89	3.06	2.78	2.43	2.67	2.43	2.12	2.43	2.20	1.93
	Standard	38 × 89	2.78	2.41	1.97	2.35	2.04	1.66	2.07	1.79	1.47
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	2.88	2.61	2.28	2.51	2.28	1.99	2.28	2.07	1.81
		38 × 140	4.53	4.11	3.59	3.95	3.59	3.14	3.59	3.26	2.85
		38 × 184	5.95	5.40	4.72	5.20	4.72	4.12	4.72	4.29	3.68
		38 × 235	7.60	6.90	6.03	6.64	6.03	5.11	6.03	5.48	4.51
		38 × 286	9.25	8.40	7.01	8.08	7.26	5.93	7.34	6.40	5.23
	No. 1 and No. 2	38 × 89	2.81	2.55	2.23	2.46	2.23	1.95	2.23	2.03	1.77
		38 × 140	4.42	4.02	3.44	3.86	3.51	2.91	3.51	3.14	2.56
		38 × 184	5.81	5.13	4.19	5.00	4.33	3.54	4.41	3.82	3.12
		38 × 235	7.24	6.27	5.12	6.12	5.30	4.33	5.40	4.67	3.82
		38 × 286	8.40	7.27	5.94	7.10	6.15	5.02	6.26	5.42	4.43
	No. 3	38 × 89	2.62	2.27	1.85	2.22	1.92	1.57	1.95	1.69	1.38
		38 × 140	3.74	3.24	2.65	3.16	2.74	2.24	2.79	2.42	1.97
		38 × 184	4.56	3.94	3.22	3.85	3.33	2.72	3.40	2.94	2.40
		38 × 235	5.57	4.82	3.94	4.71	4.08	3.33	4.15	3.60	2.94
		38 × 286	6.46	5.60	4.57	5.46	4.73	3.86	4.82	4.17	3.41
	Construction	38 × 89	2.74	2.49	2.11	2.40	2.18	1.90	2.18	1.93	1.57
	Standard	38 × 89	2.22	1.93	1.57	1.88	1.63	1.33	1.66	1.44	1.17
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-7
Maximum Spans for Roof Rafters – Specified Roof Snow Loads 2.5 and 3.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Rafter Size, mm	Maximum Span, m					
			Specified Snow Load, kPa					
			2.5			3.0		
			Rafter Spacing, mm			Rafter Spacing, mm		
			305	406	610	305	406	610
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 × 89	2.51	2.28	1.99	2.37	2.15	1.88
		38 × 140	3.95	3.59	3.14	3.72	3.38	2.95
		38 × 184	5.20	4.72	4.12	4.89	4.44	3.83
		38 × 235	6.64	6.03	5.08	6.24	5.67	4.68
		38 × 286	8.08	7.23	5.90	7.60	6.65	5.43
	No. 1 and No. 2	38 × 89	2.41	2.19	1.86	2.27	2.06	1.71
		38 × 140	3.76	3.26	2.66	3.46	3.00	2.45
		38 × 184	4.58	3.96	3.24	4.21	3.65	2.98
		38 × 235	5.60	4.85	3.96	5.15	4.46	3.64
		38 × 286	6.50	5.63	4.59	5.98	5.17	4.23
	No. 3	38 × 89	1.79	1.55	1.26	1.64	1.42	1.16
		38 × 140	2.55	2.21	1.80	2.35	2.03	1.66
		38 × 184	3.10	2.69	2.20	2.86	2.47	2.02
		38 × 235	3.80	3.29	2.68	3.49	3.02	2.47
		38 × 286	4.41	3.82	3.12	4.05	3.51	2.87
	Construction	38 × 89	2.30	2.00	1.63	2.12	1.84	1.50
	Standard	38 × 89	1.73	1.50	1.22	1.59	1.38	1.12
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 × 89	2.48	2.25	1.97	2.33	2.12	1.85
		38 × 140	3.90	3.54	3.10	3.67	3.33	2.91
		38 × 184	5.13	4.66	4.07	4.82	4.38	3.77
		38 × 235	6.55	5.95	5.01	6.16	5.60	4.61
		38 × 286	7.97	7.12	5.81	7.50	6.55	5.34
	No. 1 and No. 2	38 × 89	2.41	2.19	1.91	2.27	2.06	1.80
		38 × 140	3.79	3.42	2.79	3.57	3.14	2.57
		38 × 184	4.80	4.16	3.40	4.42	3.83	3.12
		38 × 235	5.87	5.08	4.15	5.40	4.68	3.82
		38 × 286	6.81	5.90	4.82	6.27	5.43	4.43
	No. 3	38 × 89	2.21	1.91	1.56	2.03	1.76	1.43
		38 × 140	3.15	2.73	2.23	2.90	2.51	2.05
		38 × 184	3.83	3.32	2.71	3.52	3.05	2.49
		38 × 235	4.68	4.06	3.31	4.31	3.73	3.05
		38 × 286	5.53	4.71	3.84	5.00	4.33	3.54
	Commercial	38 × 89	2.33	2.09	1.71	2.20	1.93	1.57
	Standard	38 × 89	1.81	1.57	1.28	1.66	1.44	1.18
Column 1	2	3	4	5	6	7	8	9

Table A-7 (Cont'd)
Maximum Spans for Roof Rafters – Specified Roof Snow Loads 2.5 and 3.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Rafter Size, mm	Maximum Span, m					
			Specified Snow Load, kPa					
			2.5			3.0		
			Rafter Spacing, mm			Rafter Spacing, mm		
			305	406	610	305	406	610
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 × 89	2.37	2.15	1.88	2.23	2.03	1.77
		38 × 140	3.73	3.39	2.96	3.51	3.19	2.79
		38 × 184	4.90	4.45	3.89	4.61	4.19	3.66
		38 × 235	6.26	5.69	4.97	5.89	5.35	4.68
		38 × 286	7.62	6.92	5.90	7.17	6.52	5.43
	No. 1 and No. 2	38 × 89	2.29	2.08	1.82	2.16	1.96	1.71
		38 × 140	3.61	3.28	2.86	3.40	3.08	2.66
		38 × 184	4.74	4.31	3.52	4.46	3.96	3.23
		38 × 235	6.06	5.27	4.30	5.59	4.84	3.96
		38 × 286	7.06	6.11	4.99	6.49	5.62	4.59
	No. 3	38 × 89	2.21	1.91	1.56	2.03	1.76	1.43
		38 × 140	3.15	2.73	2.23	2.90	2.51	2.05
		38 × 184	3.83	3.32	2.71	3.52	3.05	2.49
		38 × 235	4.68	4.06	3.31	4.31	3.73	3.05
		38 × 286	5.43	4.71	3.84	5.00	4.33	3.54
	Construction	38 × 89	2.25	2.05	1.77	2.12	1.93	1.63
	Standard	38 × 89	1.87	1.62	1.33	1.72	1.49	1.22
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 × 89	2.12	1.93	1.68	1.99	1.81	1.58
		38 × 140	3.33	3.03	2.65	3.14	2.85	2.49
		38 × 184	4.38	3.98	3.33	4.12	3.75	3.07
		38 × 235	5.60	4.99	4.08	5.27	4.59	3.75
		38 × 286	6.69	5.79	4.73	6.15	5.33	4.35
	No. 1 and No. 2	38 × 89	2.07	1.88	1.62	1.95	1.77	1.49
		38 × 140	3.26	2.84	2.32	3.02	2.61	2.13
		38 × 184	3.99	3.46	2.82	3.67	3.18	2.60
		38 × 235	4.88	4.23	3.45	4.49	3.89	3.17
		38 × 286	5.66	4.90	4.00	5.21	4.51	3.68
	No. 3	38 × 89	1.77	1.53	1.25	1.63	1.41	1.15
		38 × 140	2.52	2.19	1.78	2.32	2.01	1.64
		38 × 184	3.07	2.66	2.17	2.82	2.45	2.00
		38 × 235	3.76	3.25	2.66	3.45	2.99	2.44
		38 × 286	4.36	3.77	3.08	4.01	3.47	2.83
	Construction	38 × 89	2.01	1.74	1.42	1.85	1.60	1.31
	Standard	38 × 89	1.50	1.30	1.06	1.38	1.19	0.98
Column 1	2	3	4	5	6	7	8	9

Table A-8
Maximum Spans for Built-up Floor Beams Supporting Not More than One Floor(1)(2)
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, mm(3)(4)	Maximum Span, m(5)(6)								
			Size of Built-up Beam, mm								
			3 – 38 × 184	4 – 38 × 184	5 – 38 × 184	3 – 38 × 235	4 – 38 × 235	5 – 38 × 235	3 – 38 × 286	4 – 38 × 286	5 – 38 × 286
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	2.4	3.36	3.70	3.99	4.30	4.73	5.09	5.23	5.66	5.99
		3.0	3.12	3.44	3.70	3.99	4.39	4.73	4.84	5.34	5.66
		3.6	2.94	3.23	3.48	3.75	4.13	4.45	4.41	5.03	5.41
		4.2	2.79	3.07	3.31	3.52	3.92	4.23	4.09	4.72	5.14
		4.8	2.67	2.94	3.17	3.29	3.75	4.04	3.82	4.41	4.92
		5.4	2.54	2.83	3.04	3.11	3.59	3.89	3.60	4.16	4.65
		6.0	2.41	2.73	2.94	2.95	3.40	3.75	3.42	3.95	4.41
	No. 1 and No. 2	2.4	2.97	3.42	3.82	3.63	4.19	4.68	4.21	4.86	5.43
		3.0	2.65	3.06	3.42	3.24	3.75	4.19	3.76	4.35	4.86
		3.6	2.42	2.80	3.13	2.96	3.42	3.82	3.44	3.97	4.44
		4.2	2.24	2.59	2.89	2.74	3.17	3.54	3.18	3.67	4.11
		4.8	2.10	2.42	2.71	2.56	2.96	3.31	2.98	3.44	3.84
		5.4	1.98	2.28	2.55	2.42	2.79	3.12	2.81	3.24	3.62
		6.0	1.88	2.17	2.42	2.29	2.65	2.96	2.66	3.07	3.44
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	2.4	3.32	3.65	3.93	4.24	4.66	5.03	5.16	5.61	5.93
		3.0	3.08	3.39	3.65	3.93	4.33	4.66	4.76	5.27	5.61
		3.6	2.90	3.19	3.44	3.70	4.08	4.39	4.35	4.96	5.34
		4.2	2.75	3.03	3.27	3.47	3.87	4.17	4.02	4.65	5.07
		4.8	2.63	2.90	3.12	3.24	3.70	3.99	3.66	4.35	4.85
		5.4	2.49	2.79	3.00	2.95	3.53	3.83	3.32	4.10	4.58
		6.0	2.28	2.69	2.90	2.70	3.35	3.70	3.04	3.87	4.35
	No. 1 and No. 2	2.4	3.11	3.55	3.82	3.80	4.39	4.88	4.41	5.10	5.70
		3.0	2.78	3.21	3.55	3.40	3.93	4.39	3.95	4.56	5.10
		3.6	2.54	2.93	3.28	3.11	3.59	4.01	3.60	4.16	4.65
		4.2	2.35	2.72	3.04	2.88	3.32	3.71	3.34	3.85	4.31
		4.8	2.20	2.54	2.84	2.69	3.11	3.47	3.12	3.60	4.03
		5.4	2.07	2.39	2.68	2.54	2.93	3.27	2.94	3.40	3.80
		6.0	1.97	2.27	2.54	2.41	2.78	3.11	2.79	3.22	3.60
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-8 (Cont'd)
Maximum Spans for Built-up Floor Beams Supporting Not More than One Floor[1][2]
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, mm[3][4]	Maximum Span, m[5][6]								
			Size of Built-up Beam, mm								
			3 – 38 × 184	4 – 38 × 184	5 – 38 × 184	3 – 38 × 235	4 – 38 × 235	5 – 38 × 235	3 – 38 × 286	4 – 38 × 286	5 – 38 × 286
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4	3.17	3.49	3.76	4.05	4.46	4.81	4.93	5.42	5.73
		3.0	2.95	3.24	3.49	3.76	4.14	4.46	4.58	5.04	5.42
		3.6	2.77	3.05	3.29	3.54	3.90	4.20	4.31	4.74	5.11
		4.2	2.63	2.90	3.12	3.36	3.70	3.99	4.09	4.51	4.85
		4.8	2.52	2.77	2.99	3.22	3.54	3.81	3.82	4.31	4.64
		5.4	2.42	2.67	2.87	3.09	3.41	3.67	3.60	4.14	4.46
		6.0	2.34	2.57	2.77	2.95	3.29	3.54	3.32	3.95	4.31
	No. 1 and No. 2	2.4	3.07	3.38	3.64	3.92	4.32	4.65	4.57	5.25	5.59
		3.0	2.85	3.14	3.38	3.52	4.01	4.32	4.09	4.72	5.25
		3.6	2.63	2.95	3.18	3.22	3.71	4.06	3.73	4.31	4.82
		4.2	2.44	2.80	3.02	2.98	3.44	3.84	3.46	3.99	4.46
		4.8	2.28	2.63	2.89	2.79	3.22	3.60	3.23	3.73	4.17
		5.4	2.15	2.48	2.77	2.63	3.03	3.39	3.05	3.52	3.93
		6.0	2.04	2.35	2.63	2.49	2.88	3.22	2.89	3.34	3.73
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	2.4	2.84	3.12	3.36	3.62	3.99	4.30	4.33	4.85	5.23
		3.0	2.63	2.90	3.12	3.34	3.70	3.99	3.88	4.47	4.85
		3.6	2.48	2.73	2.94	3.05	3.48	3.75	3.54	4.08	4.57
		4.2	2.31	2.59	2.79	2.82	3.26	3.57	3.28	3.78	4.23
		4.8	2.16	2.48	2.67	2.64	3.05	3.41	3.06	3.54	3.96
		5.4	2.04	2.35	2.57	2.49	2.87	3.21	2.89	3.34	3.73
		6.0	1.93	2.23	2.48	2.36	2.73	3.05	2.74	3.16	3.54
	No. 1 and No. 2	2.4	2.59	2.99	3.29	3.16	3.65	4.08	3.67	4.24	4.74
		3.0	2.31	2.67	2.99	2.83	3.27	3.65	3.28	3.79	4.24
		3.6	2.11	2.44	2.73	2.58	2.98	3.33	3.00	3.46	3.87
		4.2	1.95	2.26	2.52	2.39	2.76	3.09	2.77	3.20	3.58
		4.8	1.83	2.11	2.36	2.24	2.58	2.89	2.59	3.00	3.35
		5.4	1.72	1.99	2.23	2.11	2.43	2.72	2.45	2.82	3.16
		6.0	1.64	1.89	2.11	2.00	2.31	2.58	2.32	2.68	3.00
Column 1	2	3	4	5	6	7	8	9	10	11	12

Notes to Table A-8:

(1) Beam spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floors does not exceed that specified for residential areas as described in Table 4.1.5.3.

(2) When the floors have a concrete topping of not more than 51 mm, the spans must be multiplied by 0.8.

(3) Supported length means half the sum of the joists spans on both sides of the beam.

(4) Straight interpolation may be used for other supported lengths.

(5) Spans are clear spans between supports. For total span, add two bearing lengths.

(6) 3-ply beams with supported lengths greater than 4.2 m require minimum bearing length of 114 mm. All other beams require minimum bearing length of 76 mm.

Table A-9
Maximum Spans for Built-up Floor Beams Supporting Not More than Two Floors(1)(2)
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, mm(3)(4)	Maximum Span, m(5)(6)								
			Size of Built-up Beam, mm								
			3 – 38 × 184	4 – 38 × 184	5 – 38 × 184	3 – 38 × 235	4 – 38 × 235	5 – 38 × 235	3 – 38 × 286	4 – 38 × 286	5 – 38 × 286
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	2.4	2.80	3.08	3.32	3.49	3.93	4.24	4.05	4.67	5.16
		3.0	2.55	2.86	3.08	3.12	3.60	3.93	3.62	4.18	4.67
		3.6	2.33	2.69	2.90	2.85	3.29	3.68	3.30	3.82	4.27
		4.2	2.16	2.49	2.75	2.64	3.04	3.40	2.99	3.53	3.95
		4.8	2.00	2.33	2.60	2.38	2.85	3.18	2.69	3.30	3.69
		5.4	1.82	2.20	2.45	2.17	2.68	3.00	2.45	3.08	3.48
		6.0	1.67	2.08	2.33	2.00	2.51	2.85	2.26	2.83	3.30
	No. 1 and No. 2	2.4	2.22	2.56	2.87	2.72	3.14	3.51	3.15	3.64	4.07
		3.0	1.99	2.29	2.56	2.43	2.80	3.14	2.82	3.25	3.64
		3.6	1.81	2.09	2.34	2.22	2.56	2.86	2.57	2.97	3.32
		4.2	1.68	1.94	2.17	2.05	2.37	2.65	2.38	2.75	3.07
		4.8	1.57	1.81	2.03	1.92	2.22	2.48	2.23	2.57	2.88
		5.4	1.48	1.71	1.91	1.81	2.09	2.34	2.10	2.43	2.71
		6.0	1.40	1.62	1.81	1.72	1.98	2.22	1.99	2.30	2.57
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	2.4	2.76	3.04	3.27	3.43	3.88	4.18	3.99	4.60	5.09
		3.0	2.51	2.82	3.04	2.97	3.55	3.88	3.34	4.12	4.60
		3.6	2.15	2.65	2.86	2.56	3.24	3.62	2.88	3.65	4.20
		4.2	1.90	2.40	2.72	2.26	2.85	3.35	2.55	3.21	3.87
		4.8	1.70	2.15	2.56	2.03	2.56	3.08	2.30	2.88	3.46
		5.4	1.56	1.95	2.35	1.86	2.32	2.79	2.11	2.62	3.14
		6.0	1.44	1.79	2.15	1.72	2.14	2.56	1.96	2.42	2.88
	No. 1 and No. 2	2.4	2.33	2.69	3.01	2.85	3.29	3.68	3.30	3.82	4.27
		3.0	2.08	2.41	2.69	2.55	2.94	3.29	2.96	3.41	3.82
		3.6	1.90	2.20	2.45	2.33	2.68	3.00	2.70	3.12	3.48
		4.2	1.76	2.03	2.27	2.15	2.49	2.78	2.50	2.88	3.22
		4.8	1.65	1.90	2.13	2.01	2.33	2.60	2.30	2.70	3.02
		5.4	1.55	1.79	2.00	1.86	2.19	2.45	2.11	2.54	2.84
		6.0	1.44	1.70	1.90	1.72	2.08	2.33	1.96	2.41	2.70
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-9 (Cont'd)
Maximum Spans for Built-up Floor Beams Supporting Not More than Two Floors(1)(2)
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, mm(3)(4)	Maximum Span, m(5)(6)								
			Size of Built-up Beam, mm								
			3 – 38 × 184	4 – 38 × 184	5 – 38 × 184	3 – 38 × 235	4 – 38 × 235	5 – 38 × 235	3 – 38 × 286	4 – 38 × 286	5 – 38 × 286
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4	2.64	2.91	3.13	3.37	3.71	4.00	4.05	4.52	4.87
		3.0	2.45	2.70	2.91	3.12	3.45	3.71	3.62	4.18	4.52
		3.6	2.31	2.54	2.73	2.79	3.24	3.49	3.14	3.82	4.25
		4.2	2.07	2.41	2.60	2.46	3.04	3.32	2.77	3.50	3.95
		4.8	1.85	2.31	2.48	2.21	2.79	3.17	2.50	3.14	3.69
		5.4	1.69	2.13	2.39	2.02	2.53	3.00	2.28	2.85	3.42
		6.0	1.56	1.95	2.31	1.86	2.32	2.79	2.11	2.62	3.14
	No. 1 and No. 2	2.4	2.41	2.79	3.03	2.95	3.41	3.81	3.42	3.95	4.42
		3.0	2.16	2.49	2.79	2.64	3.05	3.41	3.06	3.53	3.95
		3.6	1.97	2.27	2.54	2.41	2.78	3.11	2.79	3.23	3.61
		4.2	1.82	2.11	2.35	2.23	2.57	2.88	2.59	2.99	3.34
		4.8	1.71	1.97	2.20	2.09	2.41	2.69	2.42	2.79	3.12
		5.4	1.61	1.86	2.08	1.97	2.27	2.54	2.28	2.63	2.95
		6.0	1.53	1.76	1.97	1.86	2.15	2.41	2.11	2.50	2.79
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	2.4	2.29	2.60	2.80	2.80	3.23	3.57	3.24	3.75	4.19
		3.0	2.04	2.36	2.60	2.50	2.89	3.23	2.90	3.35	3.75
		3.6	1.87	2.16	2.41	2.28	2.64	2.95	2.65	3.06	3.42
		4.2	1.73	2.00	2.23	2.11	2.44	2.73	2.45	2.83	3.17
		4.8	1.62	1.87	2.09	1.98	2.28	2.55	2.29	2.65	2.96
		5.4	1.52	1.76	1.97	1.86	2.15	2.41	2.11	2.50	2.79
		6.0	1.44	1.67	1.87	1.72	2.04	2.28	1.96	2.37	2.65
	No. 1 and No. 2	2.4	1.94	2.24	2.50	2.37	2.73	3.06	2.75	3.17	3.55
		3.0	1.73	2.00	2.24	2.12	2.44	2.73	2.46	2.84	3.17
		3.6	1.58	1.83	2.04	1.93	2.23	2.50	2.24	2.59	2.90
		4.2	1.46	1.69	1.89	1.79	2.07	2.31	2.08	2.40	2.68
		4.8	1.37	1.58	1.77	1.67	1.93	2.16	1.94	2.24	2.51
		5.4	1.29	1.49	1.67	1.58	1.82	2.04	1.83	2.11	2.36
		6.0	1.22	1.41	1.58	1.50	1.73	1.93	1.74	2.01	2.24
Column 1	2	3	4	5	6	7	8	9	10	11	12

Notes to Table A-9:

(1) Beam spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floors does not exceed that specified for residential areas as described in Table 4.1.5.3.
(2) When the floors have a concrete topping of not more than 51 mm, the spans must be multiplied by 0.8.
(3) Supported length means half the sum of the joists spans on both sides of the beam.
(4) Straight interpolation may be used for other supported lengths.
(5) Spans are clear spans between supports. For total span, add two bearing lengths.
(6) 3-ply beams require minimum bearing length of 114 mm. 4-ply and 5-ply beams with supported lengths greater than 3 m require minimum bearing length of 114 mm. All other beams require minimum bearing length of 76 mm.

Table A-10
Maximum Spans for Built-up Floor Beams Supporting Not More than Three Floors(1)(2)
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, mm(3)(4)	Maximum Span, m(5)(6)								
			Size of Built-up Beam, mm								
			3 – 38 × 184	4 – 38 × 184	5 – 38 × 184	3 – 38 × 235	4 – 38 × 235	5 – 38 × 235	3 – 38 × 286	4 – 38 × 286	5 – 38 × 286
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	2.4	2.38	2.74	2.95	2.91	3.36	3.75	3.37	3.89	4.35
		3.0	2.13	2.46	2.74	2.60	3.00	3.36	2.92	3.48	3.89
		3.6	1.88	2.24	2.51	2.24	2.74	3.06	2.53	3.18	3.56
		4.2	1.66	2.08	2.32	1.99	2.49	2.84	2.25	2.81	3.29
		4.8	1.50	1.88	2.17	1.80	2.24	2.65	2.04	2.53	3.02
		5.4	1.38	1.71	2.05	1.65	2.04	2.44	1.88	2.31	2.75
		6.0	1.28	1.58	1.88	1.53	1.89	2.24	1.75	2.14	2.53
	No. 1 and No. 2	2.4	1.85	2.14	2.39	2.26	2.61	2.92	2.63	3.03	3.39
		3.0	1.66	1.91	2.14	2.02	2.34	2.61	2.35	2.71	3.03
		3.6	1.51	1.74	1.95	1.85	2.13	2.39	2.14	2.48	2.77
		4.2	1.40	1.62	1.81	1.71	1.98	2.21	1.99	2.29	2.56
		4.8	1.31	1.51	1.69	1.60	1.85	2.07	1.86	2.14	2.40
		5.4	1.23	1.42	1.59	1.51	1.74	1.95	1.75	2.02	2.26
		6.0	1.17	1.35	1.51	1.43	1.65	1.85	1.66	1.92	2.14
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	2.4	2.22	2.70	2.91	2.64	3.31	3.70	2.98	3.78	4.29
		3.0	1.85	2.35	2.70	2.21	2.79	3.31	2.50	3.14	3.78
		3.6	1.61	2.02	2.43	1.92	2.40	2.89	2.18	2.71	3.24
		4.2	1.43	1.78	2.14	1.71	2.13	2.54	1.95	2.40	2.86
		4.8	1.30	1.61	1.92	1.56	1.92	2.28	1.77	2.18	2.58
		5.4	1.19	1.47	1.74	1.44	1.76	2.08	1.64	2.00	2.35
		6.0	1.11	1.36	1.61	1.34	1.63	1.92	1.53	1.85	2.18
	No. 1 and No. 2	2.4	1.94	2.24	2.51	2.37	2.74	3.06	2.75	3.18	3.56
		3.0	1.74	2.00	2.24	2.12	2.45	2.74	2.46	2.84	3.18
		3.6	1.58	1.83	2.05	1.92	2.24	2.50	2.18	2.60	2.90
		4.2	1.43	1.69	1.89	1.71	2.07	2.32	1.95	2.40	2.69
		4.8	1.30	1.58	1.77	1.56	1.92	2.17	1.77	2.18	2.51
		5.4	1.19	1.47	1.67	1.44	1.76	2.04	1.64	2.00	2.35
		6.0	1.11	1.36	1.58	1.34	1.63	1.92	1.53	1.85	2.18
Column 1	2	3	4	5	6	7	8	9	10	11	12

Table A-10 (Cont'd)
Maximum Spans for Built-up Floor Beams Supporting Not More than Three Floors(1)(2)
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, mm(3)(4)	Maximum Span, m(5)(6)								
			Size of Built-up Beam, mm								
			3 – 38 × 184	4 – 38 × 184	5 – 38 × 184	3 – 38 × 235	4 – 38 × 235	5 – 38 × 235	3 – 38 × 286	4 – 38 × 286	5 – 38 × 286
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4	2.35	2.58	2.78	2.89	3.30	3.55	3.24	3.89	4.33
		3.0	2.02	2.40	2.58	2.40	3.00	3.30	2.71	3.42	3.89
		3.6	1.74	2.20	2.43	2.08	2.62	3.06	2.35	2.95	3.54
		4.2	1.55	1.94	2.31	1.85	2.31	2.77	2.10	2.61	3.12
		4.8	1.40	1.74	2.09	1.68	2.08	2.48	1.91	2.35	2.80
		5.4	1.28	1.59	1.90	1.54	1.90	2.26	1.76	2.16	2.55
		6.0	1.19	1.47	1.74	1.44	1.76	2.08	1.64	2.00	2.35
	No. 1 and No. 2	2.4	2.01	2.32	2.60	2.46	2.84	3.17	2.85	3.29	3.68
		3.0	1.80	2.08	2.32	2.20	2.54	2.84	2.55	2.95	3.29
		3.6	1.64	1.90	2.12	2.01	2.32	2.59	2.33	2.69	3.01
		4.2	1.52	1.75	2.96	1.85	2.15	2.40	2.10	2.49	2.78
		4.8	1.40	1.64	1.84	1.68	2.01	2.24	1.91	2.33	2.60
		5.4	1.28	1.55	1.73	1.54	1.89	2.12	1.76	2.16	2.46
		6.0	1.19	1.47	1.64	1.44	1.76	2.01	1.64	2.00	2.33
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	2.4	1.91	2.20	2.46	2.33	2.69	3.01	2.70	3.12	3.49
		3.0	1.70	1.97	2.20	2.08	2.41	2.69	2.42	2.79	3.12
		3.6	1.56	1.80	2.01	1.90	2.20	2.46	2.18	2.55	2.85
		4.2	1.43	1.66	1.86	1.71	2.03	2.27	1.95	2.36	2.64
		4.8	1.30	1.56	1.74	1.56	1.90	2.13	1.77	2.18	2.47
		5.4	1.19	1.47	1.64	1.44	1.76	2.01	1.64	2.00	2.33
		6.0	1.11	1.36	1.56	1.34	1.63	1.90	1.53	1.85	2.18
	No. 1 and No. 2	2.4	1.61	1.86	2.08	1.97	2.28	2.55	2.29	2.64	2.96
		3.0	1.44	1.67	1.86	1.76	2.04	2.28	2.05	2.36	2.64
		3.6	1.32	1.52	1.70	1.61	1.86	2.08	1.87	2.16	2.41
		4.2	1.22	1.41	1.57	1.49	1.72	1.93	1.73	2.00	2.23
		4.8	1.14	1.32	1.47	1.40	1.61	1.80	1.62	1.87	2.09
		5.4	1.08	1.24	1.39	1.32	1.52	1.70	1.53	1.76	1.97
		6.0	1.02	1.18	1.32	1.25	1.44	1.61	1.45	1.67	1.87
Column 1	2	3	4	5	6	7	8	9	10	11	12

Notes to Table A-10:

(1) Beam spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floors does not exceed that specified for residential areas as described in Table 4.1.5.3.
(2) When the floors have a concrete topping of not more than 51 mm, the spans must be multiplied by 0.8.
(3) Supported length means half the sum of the joists spans on both sides of the beam.
(4) Straight interpolation may be used for other supported lengths.
(5) Spans are clear spans between supports. For total span, add two bearing lengths.
(6) 3-ply beams with supported lengths greater than 4.2 m require minimum bearing length of 152 mm. All other beams require minimum bearing length of 114 mm.

Table A-11
Maximum Spans for Glue-Laminated Floor Beams – 20f-E Grade(1)
Forming Part of Sentence 9.23.4.2.(3)

Number of Storeys Supported	Beam Width, mm	Supported Length, m(2)(3)	Maximum Span, m(4)(5)(6)(7)						
			Beam Depth, mm						
			228	266	304	342	380	418	456
1	80	2.4	4.32	5.04	5.76	6.48	7.20	7.92	8.64
		3.0	3.87	4.51	5.15	5.80	6.44	7.09	7.73
		3.6	3.53	4.12	4.70	5.29	5.88	6.47	7.06
		4.2	3.27	3.81	4.36	4.90	5.44	5.99	6.53
		4.8	3.06	3.57	4.07	4.58	5.09	5.60	6.11
		5.4	2.88	3.36	3.84	4.32	4.80	5.28	5.76
		6.0	2.73	3.19	3.64	4.10	4.56	5.01	5.47
	130	2.4	5.51	6.43	7.35	8.26	9.18	10.10	11.02
		3.0	4.93	5.75	6.57	7.39	8.21	9.03	9.86
		3.6	4.50	5.25	6.00	6.75	7.50	8.25	9.00
		4.2	4.16	4.86	5.55	6.25	6.94	7.64	8.33
		4.8	3.90	4.54	5.19	5.84	6.49	7.14	7.79
		5.4	3.67	4.28	4.90	5.51	6.12	6.73	7.35
		6.0	3.48	4.07	4.65	5.23	5.81	6.39	6.97
2	80	2.4	3.28	3.83	4.37	4.92	5.47	6.01	6.56
		3.0	2.93	3.42	3.91	4.40	4.89	5.38	5.87
		3.6	2.68	3.12	3.57	4.02	4.46	4.91	5.36
		4.2	2.48	2.89	3.31	3.72	4.13	4.54	4.96
		4.8	2.32	2.71	3.09	3.48	3.86	4.25	4.64
		5.4	2.19	2.55	2.91	3.28	3.64	4.01	4.37
		6.0	2.07	2.42	2.77	3.11	3.46	3.80	4.15
	130	2.4	4.18	4.88	5.57	6.27	6.97	7.66	8.36
		3.0	3.74	4.36	4.99	5.61	6.23	6.85	7.48
		3.6	3.41	3.98	4.55	5.12	5.69	6.26	6.83
		4.2	3.16	3.69	4.21	4.74	5.27	5.79	6.32
		4.8	2.96	3.45	3.94	4.43	4.93	5.42	5.91
		5.4	2.79	3.25	3.72	4.18	4.64	5.11	5.57
		6.0	2.64	3.08	3.53	3.97	4.41	4.85	5.29
3	80	2.4	2.75	3.21	3.66	4.12	4.58	5.04	5.50
		3.0	2.46	2.87	3.28	3.69	4.10	4.51	4.92
		3.6	2.24	2.62	2.99	3.37	3.74	4.11	4.49
		4.2	2.08	2.42	2.77	3.12	3.46	3.81	4.15
		4.8	1.94	2.27	2.59	2.91	3.24	3.56	3.89
		5.4	1.83	2.14	2.44	2.75	3.05	3.36	3.66
		6.0	1.74	2.03	2.32	2.61	2.90	3.19	3.48
	130	2.4	3.50	4.09	4.67	5.25	5.84	6.42	7.01
		3.0	3.13	3.66	4.18	4.70	5.22	5.74	6.27
		3.6	2.86	3.34	3.81	4.29	4.77	5.24	5.72
		4.2	2.65	3.09	3.53	3.97	4.41	4.85	5.30
		4.8	2.48	2.89	3.30	3.72	4.13	4.54	4.95
		5.4	2.34	2.72	3.11	3.50	3.89	4.28	4.67
		6.0	2.22	2.58	2.95	3.32	3.69	4.06	4.43
Column 1	2	3	4	5	6	7	8	9	10

Notes to Table A-11:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load on the floor does not exceed that specified for residential areas as described in Table 4.1.5.3.
(2) Supported length means half the sum of the joist spans on both sides of the beam.
(3) Straight interpolation may be used for other supported lengths.
(4) Spans are valid for glued-laminated timber conforming to CAN/CSA-O122 and CSA O177.
(5) Spans are clear spans between supports. For total span, add two bearing lengths.
(6) Provide a minimum bearing length of 89 mm. (Alternatively, the bearing length may be designed in accordance with Part 4.)
(7) Top edge of beam assumed to be fully laterally supported by joists.

Table A-12
Maximum Spans for Built-up Ridge Beams and Lintels Supporting the Roof and Ceiling Only – No. 1 or No. 2 Grade
Forming Part of Sentences 9.23.4.2.(4), 9.23.12.3.(1) and (3), 9.23.13.8.(2) and 9.37.3.1.(1)

Commercial Designation	Beam or Lintel Size, mm	Maximum Span, m(1)(2)(3)				
		Specified Snow Load, kPa				
		1.0	1.5	2.0	2.5	3.0
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	3 – 38 × 184	2.65	2.28	2.03	1.85	1.71
	4 – 38 × 184	3.06	2.64	2.35	2.14	1.97
	5 – 38 × 184	3.43	2.95	2.62	2.39	2.21
	3 – 38 × 235	3.25	2.79	2.49	2.26	2.09
	4 – 38 × 235	3.75	3.22	2.87	2.61	2.41
	5 – 38 × 235	4.19	3.60	3.21	2.92	2.70
	3 – 38 × 286	3.77	3.24	2.88	2.62	2.43
	4 – 38 × 286	4.35	3.74	3.33	3.03	2.80
	5 – 38 × 286	4.86	4.18	3.72	3.39	3.13
Hem – Fir (includes Western Hemlock and Amabilis Fir)	3 – 38 × 184	2.78	2.39	2.13	1.94	1.79
	4 – 38 × 184	3.21	2.76	2.46	2.24	2.07
	5 – 38 × 184	3.59	3.09	2.75	2.50	2.31
	3 – 38 × 235	3.40	2.93	2.61	2.37	2.19
	4 – 38 × 235	3.93	3.38	3.01	2.74	2.53
	5 – 38 × 235	4.39	3.78	3.36	3.06	2.83
	3 – 38 × 286	3.95	3.40	3.02	2.75	2.54
	4 – 38 × 286	4.56	3.92	3.49	3.18	2.94
	5 – 38 × 286	5.10	4.38	3.90	3.55	3.28
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce), Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	3 – 38 × 184	2.88	2.48	2.21	2.01	1.86
	4 – 38 × 184	3.30	2.86	2.55	2.32	2.14
	5 – 38 × 184	3.55	3.10	2.82	2.59	2.40
	3 – 38 × 235	3.53	3.03	2.70	2.46	2.27
	4 – 38 × 235	4.07	3.50	3.12	2.84	2.62
	5 – 38 × 235	4.54	3.91	3.49	3.17	2.93
	3 – 38 × 286	4.09	3.52	3.13	2.85	2.63
	4 – 38 × 286	4.72	4.06	3.62	3.29	3.04
	5 – 38 × 286	5.28	4.54	4.04	3.68	3.40
Column 1	2	3	4	5	6	7

Notes to Table A-12:

(1) Beam and lintel spans are calculated based on a maximum supported length of 4.9 m. Spans may be increased by 5% for supported lengths of not more than 4.3 m, by 10% for supported lengths of not more than 3.7 m, and by 25% for supported lengths of not more than 2.4 m.

(2) For ridge beams, supported length means half the sum of the rafter, joist or truss spans on both sides of the beam. For lintels, supported length means half the sum of truss, roof joist or rafter spans supported by the lintel plus the length of the overhang beyond the lintel.

(3) Provide a minimum bearing length of 76 mm.

Table A-13
Maximum Spans for Douglas Fir – Larch Lintels – No. 1 or No. 2 Grade – Non-Structural Sheathing(1)
Forming Part of Sentences 9.23.12.3.(1) and (3) and 9.37.3.1.(1)

Lintel Supporting	Lintel Size, mm(2)	Maximum Span, m(3)(4)					
		Exterior Walls					Interior Walls
		Specified Snow Load, kPa					
		1.0	1.5	2.0	2.5	3.0	
Limited attic storage and ceiling	2 – 38 × 89	This Area Intentionally Left Blank					1.25
	2 – 38 × 140						1.78
	2 – 38 × 184						2.17
	2 – 38 × 235						2.65
	2 – 38 × 286						3.08
Roof and ceiling only (tributary width of 0.6 m maximum)(5)	2 – 38 × 89	2.68	2.34	2.13	1.97	1.86	1.97
	2 – 38 × 140	4.21	3.68	3.34	3.10	2.92	3.10
	2 – 38 × 184	5.50	4.84	4.39	4.08	3.84	4.08
	2 – 38 × 235	6.61	5.97	5.56	5.21	4.88	5.21
	2 – 38 × 286	7.66	6.92	6.44	6.09	5.66	6.09
Roof and ceiling only (tributary width of 4.9 m maximum)(6)	2 – 38 × 89	1.25	1.07	0.96	0.87	0.80	0.87
	2 – 38 × 140	1.78	1.53	1.36	1.24	1.15	1.24
	2 – 38 × 184	2.17	1.86	1.66	1.51	1.40	1.51
	2 – 38 × 235	2.65	2.28	2.03	1.85	1.71	1.85
	2 – 38 × 286	3.08	2.64	2.35	2.14	1.98	2.14
Roof, ceiling and 1 storey(3)(6)(7)	2 – 38 × 89	0.96	0.88	0.82	0.77	0.73	0.68
	2 – 38 × 140	1.37	1.26	1.17	1.10	1.04	0.97
	2 – 38 × 184	1.67	1.53	1.42	1.34	1.26	1.18
	2 – 38 × 235	2.04	1.88	1.74	1.63	1.54	1.44
	2 – 38 × 286	2.37	2.18	2.02	1.90	1.79	1.67
Roof, ceiling and 2 storeys(3)(6)(7)	2 – 38 × 89	0.86	0.81	0.77	0.73	0.70	0.61
	2 – 38 × 140	1.23	1.16	1.09	1.04	0.99	0.87
	2 – 38 × 184	1.50	1.41	1.33	1.27	1.21	1.06
	2 – 38 × 235	1.84	1.72	1.63	1.55	1.48	1.30
	2 – 38 × 286	2.13	2.00	1.89	1.80	1.72	1.51
Roof, ceiling and 3 storeys(3)(6)(7)	2 – 38 × 89	0.81	0.77	0.73	0.71	0.68	0.57
	2 – 38 × 140	1.15	1.10	1.05	1.01	0.97	0.82
	2 – 38 × 184	1.40	1.33	1.28	1.22	1.18	1.00
	2 – 38 × 235	1.71	1.63	1.56	1.50	1.44	1.22
	2 – 38 × 286	1.99	1.89	1.81	1.74	1.67	1.41
Column 1	2	3	4	5	6	7	8

Notes to Table A-13:

(1) Where structural sheathing is used, lintel spans may be increased by 15%. Structural sheathing consists of a minimum 9.5 mm thick structural panel conforming to CSA O121, CSA O151, CAN/CSA-O325.0 or CSA O437.0 fastened with at least two rows of fasteners to the exterior face of the lintel, and a single row to the top plates and studs. Fasteners shall conform to Table 9.23.3.5.

(2) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(3) If floor joists span the full width of the building without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 storey", by 20% for "Roof, ceiling and 2 storeys", and by 25% for "Roof, ceiling and 3 storeys".

(4) For ends of lintels fully supported by walls, provide minimum bearing length of 38 mm for lintel spans up to 3 m, or minimum bearing length of 76 mm for lintel spans greater than 3 m.

(5) Spans for 0.6 m tributary width are calculated for lintels in end walls that support only a 0.6 m width of roof and ceiling, but do not support roof joists, roof rafters or roof trusses.

(6) Lintel spans are calculated based on a maximum floor joist, roof joist or rafter span of 4.9 m and a maximum roof truss span of 9.8 m. Lintel spans may be increased by 5% if rafter and joist spans are not more than 4.3 m and roof truss spans are not more than 8.6 m. Spans may be increased by 10% if rafter and joist spans are not more than 3.7 m and roof trusses are not more than 7.4 m.

(7) Spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load does not exceed that specified for residential areas as described in Table 4.1.5.3.

Table A-14
Maximum Spans for Hem – Fir Lintels – No. 1 or No. 2 Grade – Non-Structural Sheathing(1)
Forming Part of Sentences 9.23.12.3.(1) and (3) and 9.37.3.1.(1)

Lintel Supporting	Lintel Size, mm(2)	Maximum Span, m(3)(4)					
		Exterior Walls					Interior Walls
		Specified Snow Load, kPa					
		1.0	1.5	2.0	2.5	3.0	
Limited attic storage and ceiling	2 – 38 × 89	This Area Intentionally Left Blank					1.31
	2 – 38 × 140						1.87
	2 – 38 × 184						2.27
	2 – 38 × 235						2.78
	2 – 38 × 286						3.23
Roof and ceiling only (tributary width of 0.6 m maximum)(5)	2 – 38 × 89	2.68	2.34	2.13	1.97	1.86	1.97
	2 – 38 × 140	4.21	3.68	3.34	3.10	2.92	3.10
	2 – 38 × 184	5.50	4.84	4.39	4.08	3.84	4.08
	2 – 38 × 235	6.61	5.97	5.56	5.21	4.90	5.21
	2 – 38 × 286	7.66	6.92	6.44	6.09	5.82	6.09
Roof and ceiling only (tributary width of 4.9 m maximum)(6)	2 – 38 × 89	1.31	1.13	1.00	0.91	0.84	0.91
	2 – 38 × 140	1.87	1.61	1.43	1.30	1.20	1.30
	2 – 38 × 184	2.27	1.95	1.74	1.58	1.42	1.58
	2 – 38 × 235	2.78	2.39	2.13	1.92	1.71	1.92
	2 – 38 × 286	3.23	2.77	2.47	2.17	1.94	2.17
Roof, ceiling and 1 storey(3)(6)(7)	2 – 38 × 89	1.01	0.93	0.86	0.81	0.76	0.69
	2 – 38 × 140	1.44	1.32	1.23	1.14	1.05	0.95
	2 – 38 × 184	1.75	1.61	1.47	1.34	1.23	1.12
	2 – 38 × 235	2.14	1.96	1.76	1.60	1.48	1.35
	2 – 38 × 286	2.49	2.22	2.00	1.82	1.69	1.55
Roof, ceiling and 2 storeys(3)(6)(7)	2 – 38 × 89	0.91	0.85	0.80	0.76	0.72	0.60
	2 – 38 × 140	1.29	1.21	1.13	1.05	0.98	0.82
	2 – 38 × 184	1.57	1.44	1.33	1.24	1.16	0.98
	2 – 38 × 235	1.90	1.73	1.60	1.49	1.40	1.19
	2 – 38 × 286	2.15	1.97	1.82	1.70	1.60	1.37
Roof, ceiling and 3 storeys(3)(6)(7)	2 – 38 × 89	0.85	0.81	0.77	0.74	0.69	0.55
	2 – 38 × 140	1.21	1.14	1.06	1.00	0.95	0.76
	2 – 38 × 184	1.43	1.33	1.25	1.18	1.12	0.91
	2 – 38 × 235	1.72	1.60	1.50	1.42	1.35	1.10
	2 – 38 × 286	1.95	1.82	1.72	1.63	1.55	1.27
Column 1	2	3	4	5	6	7	8

Notes to Table A-14:

(1) Where structural sheathing is used, lintel spans may be increased by 15%. Structural sheathing consists of a minimum 9.5 mm thick structural panel conforming to CSA O121, CSA O151, CAN/CSA-O325.0 or CSA O437.0 fastened with at least two rows of fasteners to the exterior face of the lintel, and a single row to the top plates and studs. Fasteners shall conform to Table 9.23.3.5.

(2) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(3) If floor joists span the full width of the building without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 storey", by 20% for "Roof, ceiling and 2 storeys", and by 25% for "Roof, ceiling and 3 storeys".

(4) For ends of lintels fully supported by walls, provide minimum bearing length of 38 mm for lintel spans up to 3 m, or minimum bearing length of 76 mm for lintel spans greater than 3 m.

(5) Spans for 0.6 m tributary width are calculated for lintels in end walls that support only a 0.6 m width of roof and ceiling, but do not support roof joists, roof rafters or roof trusses.

(6) Lintel spans are calculated based on a maximum floor joist, roof joist or rafter span of 4.9 m and a maximum roof truss span of 9.8 m. Lintel spans may be increased by 5% if rafter and joist spans are not more than 4.3 m and roof truss spans are not more than 8.6 m. Spans may be increased by 10% if rafter and joist spans are not more than 3.7 m and roof trusses are not more than 7.4 m.

(7) Spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load does not exceed that specified for residential areas as described in Table 4.1.5.3.

Table A-15
Maximum Spans for Spruce – Pine – Fir Lintels – No. 1 or No. 2 Grade – Non-Structural Sheathing(1)
Forming Part of Sentences 9.23.12.3.(1) and (3) and 9.37.3.1.(1)

Lintel Supporting	Lintel Size, mm(2)	Maximum Span, m(3)(4)					
		Exterior Walls					Interior Walls
		Specified Snow Load, kPa					
		1.0	1.5	2.0	2.5	3.0	
Limited attic storage and ceiling	2 – 38 × 89	This Area Intentionally Left Blank					1.27
	2 – 38 × 140						1.93
	2 – 38 × 184						2.35
	2 – 38 × 235						2.88
	2 – 38 × 286						3.34
Roof and ceiling only (tributary width of 0.6 m maximum)(5)	2 – 38 × 89	2.55	2.23	2.02	1.88	1.77	1.88
	2 – 38 × 140	4.01	3.50	3.18	2.96	2.78	2.96
	2 – 38 × 184	5.27	4.61	4.18	3.88	3.66	3.88
	2 – 38 × 235	6.37	5.76	5.34	4.96	4.67	4.96
	2 – 38 × 286	7.38	6.67	6.21	5.87	5.61	5.87
Roof and ceiling only (tributary width of 4.9 m maximum)(6)	2 – 38 × 89	1.27	1.11	1.01	0.93	0.87	0.93
	2 – 38 × 140	1.93	1.66	1.48	1.35	1.25	1.35
	2 – 38 × 184	2.35	2.02	1.80	1.64	1.52	1.64
	2 – 38 × 235	2.88	2.47	2.20	2.01	1.84	2.01
	2 – 38 × 286	3.34	2.87	2.56	2.33	2.09	2.33
Roof, ceiling and 1 storey(3)(6)(7)	2 – 38 × 89	1.05	0.96	0.89	0.84	0.79	0.74
	2 – 38 × 140	1.49	1.37	1.27	1.19	1.13	1.02
	2 – 38 × 184	1.82	1.67	1.55	1.44	1.33	1.20
	2 – 38 × 235	2.22	2.04	1.89	1.73	1.59	1.45
	2 – 38 × 286	2.58	2.36	2.15	1.96	1.81	1.66
Roof, ceiling and 2 storeys(3)(6)(7)	2 – 38 × 89	0.94	0.88	0.83	0.79	0.76	0.64
	2 – 38 × 140	1.34	1.26	1.19	1.13	1.06	0.88
	2 – 38 × 184	1.63	1.53	1.44	1.33	1.25	1.05
	2 – 38 × 235	1.99	1.87	1.72	1.60	1.50	1.27
	2 – 38 × 286	2.31	2.12	1.96	1.82	1.71	1.45
Roof, ceiling and 3 storeys(3)(6)(7)	2 – 38 × 89	0.88	0.83	0.80	0.77	0.74	0.59
	2 – 38 × 140	1.25	1.19	1.14	1.08	1.02	0.81
	2 – 38 × 184	1.52	1.44	1.35	1.27	1.21	0.97
	2 – 38 × 235	1.86	1.73	1.62	1.53	1.45	1.17
	2 – 38 × 286	2.11	1.96	1.84	1.74	1.66	1.35
Column 1	2	3	4	5	6	7	8

Notes to Table A-15:

(1) Where structural sheathing is used, lintel spans may be increased by 15%. Structural sheathing consists of a minimum 9.5 mm thick structural panel conforming to CSA O121, CSA O151, CAN/CSA-O325.0 or CSA O437.0 fastened with at least two rows of fasteners to the exterior face of the lintel, and a single row to the top plates and studs. Fasteners shall conform to Table 9.23.3.5.

(2) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(3) If floor joists span the full width of the building without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 storey", by 20% for "Roof, ceiling and 2 storeys", and by 25% for "Roof, ceiling and 3 storeys".

(4) For ends of lintels fully supported by walls, provide minimum bearing length of 38 mm for lintel spans up to 3 m, or minimum bearing length of 76 mm for lintel spans greater than 3 m.

(5) Spans for 0.6 m tributary width are calculated for lintels in end walls that support only a 0.6 m width of roof and ceiling, but do not support roof joists, roof rafters or roof trusses.

(6) Lintel spans are calculated based on a maximum floor joist, roof joist or rafter span of 4.9 m and a maximum roof truss span of 9.8 m. Lintel spans may be increased by 5% if rafter and joist spans are not more than 4.3 m and roof truss spans are not more than 8.6 m. Spans may be increased by 10% if rafter and joist spans are not more than 3.7 m and roof trusses are not more than 7.4 m.

(7) Spans apply only where the floors serve residential areas as described in Table 4.1.5.3., or the uniformly distributed live load does not exceed that specified for residential areas as described in Table 4.1.5.3.

Table A-16
Maximum Spans for Glued-Laminated Timber Lintels – 20f-E Stress Grade – Exterior Walls – Roof and Ceiling Load Only
Forming Part of Sentences 9.23.12.3.(1) and (3) and 9.37.3.1.(1)

Lintel Size, mm	Maximum Span, m(1)(2)(3)														
	Specified Snow Load, kPa														
	1.0			1.5			2.0			2.5			3.0		
	Supported Length, m(4)(5)			Supported Length, m(4)(5)			Supported Length, m(4)(5)			Supported Length, m(4)(5)			Supported Length, m(4)(5)		
	2.4	3.6	4.8	2.4	3.6	4.8	2.4	3.6	4.8	2.4	3.6	4.8	2.4	3.6	4.8
130 × 304	6.23	5.63	5.24	5.63	5.09	4.73	5.24	4.73	4.40	4.95	4.48	4.17	4.73	4.28	3.87
80 × 380	6.52	5.89	5.48	5.89	5.32	4.96	5.48	4.96	4.52	5.19	4.69	4.11	4.96	4.39	3.80
130 × 342	6.80	6.15	5.72	6.15	5.56	5.17	5.72	5.17	4.81	5.41	4.89	4.55	5.17	4.67	4.35
80 × 418	7.00	6.33	5.89	6.33	5.72	5.32	5.89	5.32	4.96	5.57	5.03	4.52	5.32	4.81	4.18
130 × 380	7.36	6.65	6.19	6.65	6.01	5.59	6.19	5.59	5.21	5.86	5.29	4.92	5.59	5.06	4.70
80 × 456	7.48	6.76	6.29	6.76	6.10	5.68	6.29	5.68	5.29	5.95	5.37	4.93	5.68	5.13	4.56
130 × 418	7.91	7.15	6.65	7.15	6.46	6.01	6.65	6.01	5.59	6.29	5.68	5.29	6.01	5.43	5.05
80 × 494	7.94	7.17	6.68	7.17	6.48	6.03	6.68	6.03	5.61	6.31	5.71	5.31	6.03	5.45	4.94
80 × 532	8.39	7.58	7.06	7.58	6.85	6.38	7.06	6.38	5.93	6.67	6.03	5.61	6.38	5.76	5.32
130 × 456	8.44	7.63	7.10	7.63	6.89	6.41	7.10	6.41	5.97	6.71	6.07	5.65	6.41	5.80	5.39
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Notes to Table A-16:

(1) Spans are valid for glued-laminated timber conforming to CAN/CSA-O122 and CSA O177.
(2) Provide a minimum bearing length of 89 mm. (Alternatively, the bearing length may be calculated in accordance with Part 4.)
(3) Top edge of lintel assumed to be fully laterally supported.
(4) Supported length means half the length of trusses or rafters, plus the length of overhang beyond the wall.
(5) For intermediate supported lengths, straight interpolation may be used.

Table A-17
Maximum Allowable Clear Spans for Lintels in Flat Loadbearing Insulating Concrete Form (ICF) Walls(1)(2)(3) (1-10M Bottom Bar)
Forming Part of Sentence 9.20.17.4.(3)

Minimum Lintel Thickness, mm	Minimum Lintel Depth, mm	Maximum Clear Span, m			
		Supporting Light-Frame Roof Only		Supporting ICF Second Storey and Light-Frame Roof	
		Maximum Ground Snow Load, kN/m²			
		1.50	3.33	1.50	3.33
140	200	1.41	1.18	1.03	0.93
	300	1.78	1.50	1.30	1.18
	400	2.08	1.75	1.53	1.38
	500	2.33	1.97	1.72	1.56
	600	2.55	2.16	1.89	1.71
150	200	1.41	1.18	1.02	0.92
	300	1.78	1.50	1.29	1.17
	400	2.08	1.75	1.51	1.37
	500	2.33	1.97	1.70	1.54
	600	2.54	2.15	1.87	1.70
160	200	1.41	1.18	1.01	0.91
	300	1.78	1.50	1.28	1.16
	400	2.07	1.75	1.50	1.36
	500	2.32	1.96	1.68	1.53
	600	2.53	2.15	1.85	1.68
190	200	1.41	1.19	0.98	0.89
	300	1.78	1.50	1.24	1.13
	400	2.06	1.74	1.45	1.32
	500	2.30	1.95	1.63	1.49
	600	2.51	2.13	1.78	1.63
200	200	1.41	1.19	0.97	0.89
	300	1.77	1.49	1.23	1.12
	400	2.06	1.74	1.43	1.31
	500	2.30	1.95	1.61	1.48
	600	2.50	2.13	1.77	1.62
240	200	1.41	1.19	0.94	0.86
	300	1.76	1.49	1.18	1.09
	400	2.04	1.73	1.38	1.27
	500	2.27	1.93	1.55	1.43
	600	2.47	2.11	1.70	1.56
Column 1	2	3	4	5	6

Notes to Table A-17:

(1) Deflection criteria is L/240, where "L" is the clear span of the lintel.
(2) Linear interpolation is permitted between ground snow loads and between lintel depths.
(3) 10M stirrups are required at a maximum d/2 spacing for spans greater than 1 200 mm, where "d" is the distance from the top of the lintel to the level of the bottom reinforcing bar in the lintel.

Table A-18
Maximum Allowable Clear Spans for Lintels in Flat Loadbearing Insulating Concrete Form (ICF) Walls(1)(2)(3) (1-15M Bottom Bar)
Forming Part of Sentence 9.20.17.4.(3)

Minimum Lintel Thickness, mm	Minimum Lintel Depth, mm	Maximum Clear Span, m			
		Supporting Light-Frame Roof Only		Supporting ICF Second Storey and Light-Frame Roof	
		Maximum Ground Snow Load, kN/m²			
		1.50	3.33	1.50	3.33
140	200	1.63	1.46	1.31	1.23
	300	2.43	2.08	1.81	1.64
	400	2.90	2.44	2.13	1.93
	500	3.26	2.75	2.41	2.18
	600	3.58	3.03	2.65	2.40
150	200	1.67	1.49	1.33	1.25
	300	2.48	2.08	1.79	1.62
	400	2.90	2.44	2.11	1.91
	500	3.26	2.75	2.38	2.16
	600	3.57	3.02	2.62	2.38
160	200	1.70	1.53	1.35	1.26
	300	2.48	2.08	1.78	1.61
	400	2.90	2.44	2.09	1.90
	500	3.25	2.75	2.36	2.14
	600	3.56	3.02	2.59	2.36
190	200	1.80	1.61	1.36	1.24
	300	2.48	2.09	1.73	1.58
	400	2.89	2.44	2.03	1.85
	500	3.23	2.74	2.29	2.09
	600	3.53	3.00	2.51	2.30
200	200	1.83	1.64	1.35	1.23
	300	2.48	2.09	1.71	1.57
	400	2.88	2.44	2.01	1.84
	500	3.22	2.74	2.26	2.07
	600	3.52	2.99	2.48	2.28
240	200	1.93	1.65	1.30	1.20
	300	2.47	2.08	1.66	1.52
	400	2.86	2.43	2.94	1.78
	500	3.19	2.72	2.18	2.01
	600	3.47	2.97	2.39	2.20
Column 1	2	3	4	5	6

Notes to Table A-18:

(1) Deflection criteria is L/240, where "L" is the clear span of the lintel.
(2) Linear interpolation is permitted between ground snow loads and between lintel depths.
(3) 10M stirrups are required at a maximum d/2 spacing for spans greater than 1 200 mm, where "d" is the distance from the top of the lintel to the level of the bottom reinforcing bar in the lintel.

Table A-19
Maximum Allowable Clear Spans for Lintels in Flat Loadbearing Insulating Concrete Form (ICF) Walls(1)(2)(3) (2-15M Bottom Bar)
Forming Part of Sentence 9.20.17.4.(3)

Minimum Lintel Thickness, mm	Minimum Lintel Depth, mm	Maximum Clear Span, m			
		Supporting Light-Frame Roof Only		Supporting ICF Second Storey and Light-Frame Roof	
		Maximum Ground Snow Load, kN/m²			
		1.50	3.33	1.50	3.33
140	200	1.63	1.46	1.31	1.23
	300	2.43	2.18	1.96	1.84
	400	3.22	2.90	2.60	2.42
	500	4.00	3.60	3.25	2.70
	600	4.71	4.20	3.61	2.97
150	200	1.67	1.49	1.33	1.25
	300	2.48	2.23	1.99	1.87
	400	3.29	2.96	2.64	2.45
	500	4.80	3.68	3.29	2.74
	600	4.87	4.20	3.64	3.02
160	200	1.70	1.53	1.35	1.27
	300	2.53	2.28	2.02	1.90
	400	3.36	3.02	2.68	2.48
	500	4.16	3.76	3.27	2.78
	600	4.95	4.20	3.61	3.08
190	200	1.80	1.61	1.39	1.32
	300	2.67	2.40	2.09	1.97
	400	3.53	3.19	2.77	2.56
	500	4.38	3.81	3.18	2.90
	600	4.92	4.19	3.50	3.21
200	200	1.83	1.64	1.41	1.33
	300	2.87	2.44	2.11	2.00
	400	3.78	3.24	2.79	2.55
	500	4.46	3.81	3.15	2.89
	600	4.86	4.18	3.47	3.18
240	200	2.07	1.74	1.46	1.38
	300	3.07	2.59	2.18	2.07
	400	3.95	3.38	2.70	2.48
	500	4.40	3.80	3.04	2.80
	600	4.78	4.16	3.34	3.08
Column 1	2	3	4	5	6

Notes to Table A-19:

(1) Deflection criteria is L/240, where "L" is the clear span of the lintel.

(2) Linear interpolation is permitted between ground snow loads and between lintel depths.

(3) 10M stirrups are required at a maximum d/2 spacing for spans greater than 1 200 mm, where "d" is the distance from the top of the lintel to the level of the bottom reinforcing bar in the lintel.

Table A-20
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units
Where Beams Support Exterior Stud Walls With Brick Veneer – 1.0 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

	Maximum Span, m								
Roof Live Load, kPa		1.0							
Supported Roof Length, m[1]		2.4		3.6		4.8		6.0	
Supported Floor Length, m[2]		2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section	W 150 × 22	2.96	2.79	2.86	2.71	2.78	2.65	2.71	2.59
	W 150 × 30	3.32	3.14	3.22	3.05	3.13	2.98	3.04	2.91
	W 150 × 37	3.62	3.41	3.50	3.32	3.40	3.24	3.32	3.17
	W 200 × 27	3.80	3.59	3.68	3.49	3.58	3.41	3.49	3.33
	W 200 × 31	4.06	3.83	3.93	3.73	3.82	3.64	3.72	3.56
	W 200 × 36	4.17	3.94	4.04	3.83	3.93	3.74	3.82	3.65
	W 200 × 42	4.42	4.18	4.29	4.06	4.16	3.96	4.05	3.87
	W 250 × 33	4.71	4.44	4.56	4.32	4.43	4.22	4.31	4.12
	W 250 × 39	5.04	4.76	4.88	4.63	4.75	4.52	4.62	4.41
	W 250 × 49	5.32	5.02	5.15	4.89	5.01	4.77	4.87	4.66
	W 310 × 39	5.66	5.34	5.49	5.20	5.33	5.07	5.19	4.96
	W 310 × 45	5.96	5.62	5.77	5.47	5.61	5.34	5.46	5.22
	W 310 × 52	6.33	5.98	6.13	5.82	5.96	5.67	5.8	5.54
	W 310 × 60	6.50	6.14	6.30	5.98	6.12	5.83	5.96	5.69
	W 360 × 33	5.61	5.29	5.43	5.15	5.28	5.03	5.14	4.91
	W 360 × 39	6.01	5.68	5.83	5.53	5.66	5.39	5.51	5.27
	W 360 × 45	6.38	6.03	6.19	5.87	6.01	5.72	5.85	5.59
	W 360 × 51	6.70	6.32	6.49	6.16	6.31	6.00	6.14	5.87
	W 360 × 57	7.00	6.61	6.78	6.43	6.59	6.28	6.42	6.13
Column 1		2	3	4	5	6	7	8	9

Notes to Table A-20:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.
(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-21
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units
Where Beams Support Interior Stud Walls or Exterior Stud Walls With Siding – 1.0 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

Maximum Span, m									
Roof Live Load, kPa		1.0							
Supported Roof Length, m[1]		2.4		3.6		4.8		6.0	
Supported Floor Length, m[2]		2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section	W 150 × 22	4.20	3.82	3.98	3.67	3.81	3.51	3.66	3.35
	W 150 × 30	4.72	4.30	4.48	4.13	4.28	3.98	4.11	3.85
	W 150 × 37	5.14	4.68	4.88	4.49	4.66	4.33	4.48	4.19
	W 200 × 27	5.41	4.92	5.13	4.72	4.90	4.56	4.71	4.41
	W 200 × 31	5.77	5.25	5.48	5.04	5.23	4.86	5.02	4.71
	W 200 × 36	5.93	5.40	5.63	5.18	5.38	5.00	5.16	4.84
	W 200 × 42	6.29	5.72	5.97	5.50	5.70	5.30	5.47	5.13
	W 250 × 33	6.69	6.09	6.35	5.85	6.06	5.64	5.82	5.45
	W 250 × 39	7.17	6.52	6.80	6.26	6.49	6.04	6.24	5.85
	W 250 × 49	7.56	6.88	7.17	6.61	6.85	6.37	6.58	6.17
	W 310 × 39	8.05	7.32	7.63	7.03	7.29	6.78	7.01	6.56
	W 310 × 45	8.47	7.71	8.03	7.40	7.68	7.14	7.37	6.91
Column 1		2	3	4	5	6	7	8	9

Notes to Table A-21:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.

(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-22
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units Where Beams Support Exterior Stud Walls With Brick Veneer – 1.5 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

		Maximum Span, m							
Roof Live Load, kPa		1.5							
Supported Roof Length, m(1)		2.4		3.6		4.8		6.0	
Supported Floor Length, m(2)		2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section	W 150 × 22	2.86	2.71	2.74	2.62	2.64	2.53	2.55	2.46
	W 150 × 30	3.22	3.05	3.08	2.94	2.97	2.85	2.87	2.76
	W 150 × 37	3.50	3.32	3.36	3.20	3.23	3.10	3.13	3.01
	W 200 × 27	3.68	3.49	3.53	3.37	3.40	3.26	3.29	3.16
	W 200 × 31	3.93	3.73	3.77	3.60	3.63	3.48	3.51	3.38
	W 200 × 36	4.04	3.83	3.88	3.70	3.73	3.58	3.61	3.47
	W 200 × 42	4.29	4.06	4.11	3.92	3.96	3.79	3.82	3.68
	W 250 × 33	4.56	4.32	4.37	4.17	4.21	4.03	4.07	3.91
	W 250 × 39	4.88	4.63	4.68	4.47	4.51	4.32	4.36	4.19
	W 250 × 49	5.15	4.89	4.94	4.71	4.76	4.56	4.60	4.42
	W 310 × 39	5.49	5.20	5.26	5.01	5.06	4.85	4.89	4.71
	W 310 × 45	5.77	5.47	5.53	5.28	5.33	5.11	5.15	4.95
	W 310 × 52	6.13	5.82	5.88	5.61	5.66	5.43	5.47	5.26
	W 310 × 60	6.30	5.98	6.04	5.76	5.81	5.57	5.62	5.41
	W 360 × 33	5.43	5.15	5.21	4.97	5.01	4.81	4.85	4.66
	W 360 × 39	5.83	5.53	5.58	5.33	5.38	5.15	5.20	5.00
	W 360 × 45	6.19	5.87	5.93	5.65	5.71	5.47	5.52	5.31
	W 360 × 51	6.49	6.16	6.22	5.93	5.99	5.74	5.79	5.57
	W 360 × 57	6.78	6.43	6.50	6.20	6.26	6.00	6.05	5.82
Column 1		2	3	4	5	6	7	8	9

Notes to Table A-22:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.

(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-23
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units
Where Beams Support Interior Stud Walls or Exterior Stud Walls With Siding – 1.5 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

		Maximum Span, m							
Roof Live Load, kPa		1.5							
Supported Roof Length, m[1]		2.4		3.6		4.8		6.0	
Supported Floor Length, m[2]		2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section	W 150 × 22	3.98	3.67	3.73	3.48	3.53	3.30	3.36	3.12
	W 150 × 30	4.48	4.13	4.19	3.91	3.97	3.74	3.78	3.59
	W 150 × 37	4.88	4.49	4.56	4.26	4.32	4.07	4.12	3.91
	W 200 × 27	5.13	4.72	4.80	4.48	4.54	4.28	4.33	4.11
	W 200 × 31	5.48	5.04	5.12	4.78	4.85	4.57	4.62	4.39
	W 200 × 36	5.63	5.18	5.27	4.92	4.98	4.70	4.75	4.51
	W 200 × 42	5.97	5.50	5.58	5.21	5.28	4.98	5.04	4.78
	W 250 × 33	6.35	5.85	5.94	5.54	5.62	5.30	5.36	5.09
	W 250 × 39	6.80	6.26	6.36	5.94	6.02	5.67	5.74	5.45
	W 250 × 49	7.17	6.61	6.71	6.27	6.35	5.99	6.06	5.75
	W 310 × 39	7.63	7.03	7.14	6.67	6.76	6.37	6.45	6.12
	W 310 × 45	8.03	7.40	7.52	7.02	7.11	6.71	6.78	6.44
Column 1		2	3	4	5	6	7	8	9

Notes to Table A-23:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.
(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-24
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units Where Beams Support Exterior Stud Walls With Brick Veneer – 2.0 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

	Maximum Span, m							
Roof Live Load, kPa	2.0							
Supported Roof Length, m(1)	2.4		3.6		4.8		6.0	
Supported Floor Length, m(2)	2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section: W 150 × 22	2.78	2.65	2.64	2.53	2.53	2.43	2.43	2.35
W 150 × 30	3.13	2.98	2.97	2.85	2.84	2.74	2.73	2.64
W 150 × 37	3.40	3.24	3.23	3.10	3.09	2.98	2.97	2.88
W 200 × 27	3.58	3.41	3.40	3.26	3.25	3.13	3.13	3.02
W 200 × 31	3.82	3.64	3.63	3.48	3.47	3.34	3.34	3.23
W 200 × 36	3.93	3.74	3.73	3.58	3.57	3.44	3.43	3.32
W 200 × 42	4.16	3.96	3.96	3.79	3.78	3.64	3.64	3.52
W 250 × 33	4.43	4.22	4.21	4.03	4.02	3.88	3.87	3.74
W 250 × 39	4.75	4.52	4.51	4.32	4.31	4.15	4.15	4.01
W 250 × 49	5.01	4.77	4.76	4.56	4.55	4.38	4.37	4.23
W 310 × 39	5.33	5.07	5.06	4.85	4.84	4.66	4.65	4.50
W 310 × 45	5.61	5.34	5.33	5.11	5.10	4.91	4.90	4.74
W 310 × 52	5.96	5.67	5.66	5.43	5.41	5.21	5.21	5.03
W 310 × 60	6.12	5.83	5.81	5.57	5.56	5.36	5.35	5.17
W 360 × 33	5.28	5.03	5.01	4.81	4.80	4.62	4.61	4.46
W 360 × 39	5.66	5.39	5.38	5.15	5.14	4.95	4.94	4.78
W 360 × 45	6.01	5.72	5.71	5.47	5.46	5.26	5.25	5.08
W 360 × 51	6.31	6.00	5.99	5.74	5.73	5.52	5.51	5.33
W 360 × 57	6.59	6.28	6.26	6.00	5.99	5.77	5.76	5.57
Column 1	2	3	4	5	6	7	8	9

Notes to Table A-24:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.
(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-25
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units
Where Beams Support Interior Stud Walls or Exterior Stud Walls With Siding – 2.0 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

	Maximum Span, m								
Roof Live Load, kPa		2.0							
Supported Roof Length, m[1]		2.4		3.6		4.8		6.0	
Supported Floor Length, m[2]		2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section	W 150 × 22	3.81	3.54	3.53	3.33	3.32	3.13	3.15	2.94
	W 150 × 30	4.28	3.98	3.97	3.74	3.73	3.55	3.54	3.39
	W 150 × 37	4.66	4.33	4.32	4.70	4.06	3.86	3.85	3.69
	W 200 × 27	4.90	4.56	4.54	4.28	4.27	4.06	4.05	3.88
	W 200 × 31	5.23	4.86	4.85	4.57	4.56	4.34	4.32	4.14
	W 200 × 36	5.38	5.00	4.98	4.07	4.68	4.46	4.45	4.26
	W 200 × 42	5.70	5.30	5.28	4.98	4.96	4.72	4.71	4.51
	W 250 × 33	6.06	5.64	5.62	5.30	5.28	5.03	5.01	4.80
	W 250 × 39	6.49	6.04	6.02	5.67	5.66	5.38	5.37	5.14
	W 250 × 49	6.85	6.37	6.35	5.99	5.97	5.68	5.67	5.43
	W 310 × 39	7.29	6.78	6.76	6.37	6.35	6.04	6.03	5.77
	W 310 × 45	7.68	7.14	7.11	6.71	6.69	6.36	6.35	6.08
Column 1		2	3	4	5	6	7	8	9

Notes to Table A-25:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.

(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-26
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units Where Beams Support Exterior Stud Walls With Brick Veneer – 2.5 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

	Maximum Span, m							
Roof Live Load, kPa	2.5							
Supported Roof Length, m[1]	2.4		3.6		4.8		6.0	
Supported Floor Length, m[2]	2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section								
W 150 × 22	2.71	2.59	2.55	2.46	2.43	2.35	2.33	2.26
W 150 × 30	3.04	2.91	2.87	2.76	2.73	2.64	2.62	2.54
W 150 × 37	3.32	3.17	3.13	3.01	2.97	2.88	2.85	2.77
W 200 × 27	3.49	3.33	3.29	3.16	3.13	3.02	2.99	2.91
W 200 × 31	3.72	3.56	3.51	3.38	3.34	3.23	3.20	3.10
W 200 × 36	3.82	3.65	3.61	3.47	3.43	3.32	3.29	3.19
W 200 × 42	4.05	3.87	3.82	3.68	3.64	3.52	3.48	3.38
W 250 × 33	4.31	4.12	4.07	3.91	3.87	3.74	3.71	3.60
W 250 × 39	4.62	4.41	4.36	4.19	4.15	4.01	3.97	3.85
W 250 × 49	4.87	4.66	4.60	4.42	4.37	4.23	4.19	4.07
W 310 × 39	5.19	4.96	4.89	4.71	4.65	4.50	4.46	4.33
W 310 × 45	5.46	5.22	5.15	4.95	4.90	4.74	4.69	4.55
W 310 × 52	5.80	5.54	5.47	5.26	5.21	5.03	4.98	4.84
W 310 × 60	5.96	5.69	5.62	5.41	5.35	5.17	5.12	4.97
W 360 × 33	5.14	4.91	4.85	4.66	4.61	4.46	4.42	4.29
W 360 × 39	5.51	5.27	5.20	5.00	4.94	4.78	4.73	4.60
W 360 × 45	5.85	5.59	5.52	5.31	5.25	5.08	5.03	4.88
W 360 × 51	6.14	5.87	5.79	5.57	5.51	5.33	5.27	5.12
W 360 × 57	6.42	6.13	6.05	5.82	5.76	5.57	5.51	5.35
Column 1	2	3	4	5	6	7	8	9

Notes to Table A-26:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.
(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-27
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units Where Beams Support Interior Stud Walls or Exterior Stud Walls With Siding – 2.5 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

		Maximum Span, m							
Roof Live Load, kPa		2.5							
Supported Roof Length, m[1]		2.4		3.6		4.8		6.0	
Supported Floor Length, m[2]		2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section	W 150 × 22	3.66	3.43	3.36	3.19	3.15	2.98	2.98	2.79
	W 150 × 30	4.11	3.85	3.78	3.59	3.54	3.39	3.35	3.23
	W 150 × 37	4.48	4.19	4.12	3.91	3.85	3.69	3.64	3.51
	W 200 × 27	4.71	4.41	4.33	4.11	4.05	3.88	3.83	3.69
	W 200 × 31	5.02	4.71	4.62	4.39	4.32	4.14	4.09	3.94
	W 200 × 36	5.16	4.84	4.75	4.51	4.45	4.26	4.21	4.05
	W 200 × 42	5.47	5.13	5.04	4.78	4.71	4.51	4.46	4.30
	W 250 × 33	5.82	5.46	5.36	5.09	5.01	4.80	4.74	4.54
	W 250 × 39	6.24	5.85	5.74	5.45	5.37	5.14	5.08	4.90
	W 250 × 49	6.58	6.17	6.06	5.75	5.67	5.43	5.36	5.17
	W 310 × 39	7.01	6.56	6.45	6.12	6.03	5.78	5.70	5.47
	W 310 × 45	7.37	6.91	6.78	6.44	6.35	6.08	6.00	5.79
Column 1		2	3	4	5	6	7	8	9

Notes to Table A-27:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.

(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-28
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units Where Beams Support Exterior Stud Walls With Brick Veneer – 3.0 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

Maximum Span, m									
Roof Live Load, kPa		3.0							
Supported Roof Length, m[1]		2.4		3.6		4.8		6.0	
Supported Floor Length, m[2]		2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section	W 150 × 22	2.64	2.53	2.48	2.39	2.35	2.28	2.24	2.18
	W 150 × 30	2.97	2.85	2.78	2.69	2.64	2.56	2.52	2.45
	W 150 × 37	3.23	3.10	3.03	2.93	2.87	2.79	2.74	2.67
	W 200 × 27	3.40	3.26	3.19	3.08	3.02	2.93	2.88	2.81
	W 200 × 31	3.63	3.48	3.40	3.28	3.22	3.13	3.08	3.00
	W 200 × 36	3.73	3.58	3.50	3.38	3.31	3.21	3.16	3.08
	W 200 × 42	3.96	3.79	3.71	3.58	3.51	3.41	3.35	3.26
	W 250 × 33	4.21	4.03	3.94	3.81	3.74	3.62	3.57	3.47
	W 250 × 39	4.51	4.32	4.23	4.08	4.00	3.88	3.82	3.72
	W 250 × 49	4.76	4.56	4.46	4.30	4.22	4.10	4.03	3.93
	W 310 × 39	5.06	4.85	4.74	4.58	4.49	4.36	4.29	4.18
	W 310 × 45	5.33	5.11	4.99	4.82	4.73	4.59	4.51	4.40
	W 310 × 52	5.66	5.43	5.31	5.12	5.03	4.88	4.80	4.67
	W 310 × 60	5.81	5.57	5.45	5.26	5.16	5.01	4.93	4.80
	W 360 × 33	5.01	4.81	4.70	4.54	4.45	4.32	4.25	4.14
	W 360 × 39	5.38	5.15	5.04	4.86	4.77	4.63	4.56	4.44
	W 360 × 45	5.71	5.47	5.35	5.16	5.07	4.92	4.84	4.71
	W 360 × 51	5.99	5.74	5.61	5.42	5.32	5.16	5.08	4.94
	W 360 × 57	6.26	6.00	5.87	5.66	5.56	5.39	5.31	5.17
Column 1		2	3	4	5	6	7	8	9

Notes to Table A-28:

(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.
(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-29
Maximum Spans for Steel Beams Supporting a Roof and One Floor in Dwelling Units
Where Beams Support Interior Stud Walls or Exterior Stud Walls With Siding – 3.0 kPa Specified Roof Design Snow Load
Forming Part of Sentence 9.23.4.3.(1)

		Maximum Span, m							
Roof Live Load, kPa		3.0							
Supported Roof Length, m[1]		2.4		3.6		4.8		6.0	
Supported Floor Length, m[2]		2.4	3.6	2.4	3.6	2.4	3.6	2.4	3.6
Steel Beam Section	W 150 × 22	3.53	3.33	3.23	3.08	3.01	2.85	2.83	2.66
	W 150 × 30	3.97	3.74	3.63	3.47	3.38	3.26	3.19	3.09
	W 150 × 37	4.32	4.07	3.95	3.77	3.68	3.55	3.48	3.37
	W 200 × 27	4.54	4.28	4.15	3.97	3.87	3.73	3.65	3.52
	W 200 × 31	4.85	4.57	4.43	4.23	4.13	3.98	3.90	3.78
	W 200 × 36	4.98	4.70	4.56	4.35	4.25	4.09	4.01	3.88
	W 200 × 42	5.28	4.98	4.83	4.61	4.50	4.34	4.25	4.12
	W 250 × 33	5.62	5.30	5.14	4.91	4.79	4.61	4.52	4.33
	W 250 × 39	6.02	5.67	5.51	5.26	5.13	4.94	4.84	4.69
	W 250 × 49	6.35	5.99	5.81	5.55	5.42	5.21	5.11	4.95
	W 310 × 39	6.76	6.37	6.18	5.90	5.76	5.55	5.44	5.21
	W 310 × 45	7.11	6.71	6.51	6.21	6.07	5.84	5.72	5.54
Column 1		2	3	4	5	6	7	8	9

Notes to Table A-29:
(1) Supported roof length means half the sum of the roof framing spans on both sides of the beam.
(2) Supported floor length means half the sum of the floor framing spans on both sides of the beam.

Table A-30
Sizes for Spruce-Pine-Fir No. 2 Grade Exterior Wall Studs With Brick Veneer[(1)(2)]
Forming Part of Sentence 9.23.10.1.(2)

Stud Size and Spacing									
Hourly Wind Pressure (1/50), kPa		0.40		0.45		0.50		0.60	
Specified Roof Snow Load, kPa	Stud Length, m	Supported Roof Length, m		Supported Roof Length, m		Supported Roof Length, m		Supported Roof Length, m	
		3.0	6.0	3.0	6.0	3.0	6.0	3.0	6.0
1.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	B	B	B	B
	4.6	B	B	B	B	C	C	C	C
	5.0	C	C	C	C	C	C	D	D
	5.3	C	C	C	C	D	D	D	D
	5.6	C	C	D	D	D	D		
1.5	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	B	B	B	B
	4.6	B	B	B	B	C	C	C	C
	5.0	C	C	C	C	C	C	D	D
	5.3	C	C	C	C	D	D	D	D
	5.6	C	C	D	D	D	D		
2.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	B	B	B	B
	4.6	B	B	B	B	C	C	C	C
	5.0	C	C	C	C	C	C	D	D
	5.3	C	C	C	C	D	D	D	D
	5.6	C	C	D	D	D	D		
2.5	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	B	B	B	B
	4.6	B	B	B	B	C	C	C	C
	5.0	C	C	C	C	C	C	D	D
	5.3	C	C	C	C	D	D	D	D
	5.6	C	C	D	D	D	D		
3.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	B	B	B	B
	4.6	B	B	B	B	C	C	C	C
	5.0	C	C	C	C	C	C	D	D
	5.3	C	C	C	C	D	D	D	D
	5.6	C	C	D	D	D	D		
Column 1	2	3	4	5	6	7	8	9	10

Legend - Stud Size and Spacing

A = 38 × 140 mm at 406 mm on centre

B = 38 × 140 mm at 305 mm on centre

C = two 38 × 140 mm studs at 406 mm on centre

D = two 38 × 140 mm studs at 305 mm on centre

Notes to Table A-30:

(1) A roof dead load of 0.5 kPa has been assumed. The Table does not apply where the stud supports additional loads from heavy roofing materials such as concrete tiles or clay roofing tiles.

(2) Wall construction shall conform to the requirements of Sentence 9.23.10.1.(2).

Table A-31
Sizes for Spruce-Pine-Fir No. 2 Grade Exterior Wall Studs With Siding[1][2]
Forming Part of Sentence 9.23.10.1.(2)

Stud Size and Spacing									
Hourly Wind Pressure (1/50), kPa		0.40		0.45		0.50		0.60	
Specified Roof Snow Load, kPa	Stud Length, m	Supported Roof Length, m		Supported Roof Length, m		Supported Roof Length, m		Supported Roof Length, m	
		3.0	6.0	3.0	6.0	3.0	6.0	3.0	6.0
1.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	A	A
	5.0	A	A	A	A	A	A	B	B
	5.3	A	A	A	A	B	B	B	B
	5.6	A	A	B	B	B	B	C	C
1.5	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	A	A
	5.0	A	A	A	A	A	A	B	B
	5.3	A	A	A	A	B	B	B	B
	5.6	A	A	B	B	B	B	C	C
2.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	A	A
	5.0	A	A	A	A	A	A	B	B
	5.3	A	A	A	A	B	B	B	B
	5.6	A	A	B	B	B	B	C	C
2.5	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	A	A
	5.0	A	A	A	A	A	A	B	B
	5.3	A	A	A	A	B	B	B	B
	5.6	A	B	B	B	B	B	C	C
3.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	A	A
	5.0	A	A	A	A	A	A	B	B
	5.3	A	B	A	B	B	B	B	B
	5.6	A	B	B	B	B	B	C	C
Column 1	2	3	4	5	6	7	8	9	10

Legend - Stud Size and Spacing

A = 38 × 140 mm at 406 mm on centre
B = 38 × 140 mm at 305 mm on centre
C = two 38 × 140 mm studs at 406 mm on centre
D = two 38 × 140 mm studs at 305 mm on centre

Notes to Table A-31:

(1) A roof dead load of 0.5 kPa has been assumed. The Table does not apply where the stud supports additional loads from heavy roofing materials such as concrete tiles or clay roofing tiles.
(2) Wall construction shall conform to the requirements of Sentence 9.23.10.1.(2).

Table A-32
Sizes for Northern Species No. 2 Grade Exterior Wall Studs With Brick Veneer(1)(2)
Forming Part of Sentence 9.23.10.1.(2)

Stud Size and Spacing									
Hourly Wind Pressure (1/50), kPa		0.40		0.45		0.50		0.60	
Specified Roof Snow Load, kPa	Stud Length, m	Supported Roof Length, m		Supported Roof Length, m		Supported Roof Length, m		Supported Roof Length, m	
		3.0	6.0	3.0	6.0	3.0	6.0	3.0	6.0
1.0	3.8	A	A	A	A	B	B	B	B
	4.2	B	B	B	B	C	C	C	C
	4.6	C	C	C	C	C	C	D	D
	5.0	C	C	D	D	D	D		
	5.3	D	D	D	D				
	5.6								
1.5	3.8	A	A	A	A	B	B	B	B
	4.2	B	B	B	B	C	C	C	C
	4.6	C	C	C	C	C	C	D	D
	5.0	C	C	D	D	D	D		
	5.3	D	D	D	D				
	5.6								
2.0	3.8	A	A	A	A	B	B	B	B
	4.2	B	B	B	B	C	C	C	C
	4.6	C	C	C	C	C	C	D	D
	5.0	C	C	D	D	D	D		
	5.3	D	D	D	D				
	5.6								
2.5	3.8	A	A	A	A	B	B	B	B
	4.2	B	B	B	B	C	C	C	C
	4.6	C	C	C	C	C	C	D	D
	5.0	C	C	D	D	D	D		
	5.3	D	D	D	D				
	5.6								
3.0	3.8	A	A	A	A	B	B	B	B
	4.2	B	B	B	B	C	C	C	C
	4.6	C	C	C	C	C	C	D	D
	5.0	C	C	D	D	D	D		
	5.3	D	D	D	D				
	5.6								
Column 1	2	3	4	5	6	7	8	9	10

Legend - Stud Size and Spacing

A = 38 × 140 mm at 406 mm on centre

B = 38 × 140 mm at 305 mm on centre

C = two 38 × 140 mm studs at 406 mm on centre

D = two 38 × 140 mm studs at 305 mm on centre

Notes to Table A-32:

(1) A roof dead load of 0.5 kPa has been assumed. The Table does not apply where the stud supports additional loads from heavy roofing materials such as concrete tiles or clay roofing tiles.

(2) Wall construction shall conform to the requirements of Sentence 9.23.10.1.(2).

Table A-33
Sizes for Northern Species No. 2 Grade Exterior Wall Studs With Siding(1)(2)
Forming Part of Sentence 9.23.10.1.(2)

Stud Size and Spacing									
Hourly Wind Pressure (1/50), kPa		0.40		0.45		0.50		0.60	
Specified Roof Snow Load, kPa	Stud Length, m	Supported Roof Length, m		Supported Roof Length, m		Supported Roof Length, m		Supported Roof Length, m	
		3.0	6.0	3.0	6.0	3.0	6.0	3.0	6.0
1.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	B	B
	5.0	A	A	B	B	B	B	C	C
	5.3	B	B	B	B	C	C	C	C
	5.6	C	C	C	C	C	C	D	D
1.5	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	B	B
	5.0	A	A	B	B	B	B	C	C
	5.3	B	B	B	B	C	C	C	C
	5.6	C	C	C	C	C	C	D	D
2.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	B	B
	5.0	A	A	B	B	B	B	C	C
	5.3	B	B	B	B	C	C	C	C
	5.6	C	C	C	C	C	C	D	D
2.5	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	A	A	A	A	A	B	B
	5.0	A	B	B	B	B	B	C	C
	5.3	B	B	B	B	C	C	C	C
	5.6	C	C	C	C	C	C	D	D
3.0	3.8	A	A	A	A	A	A	A	A
	4.2	A	A	A	A	A	A	A	A
	4.6	A	B	A	B	A	B	B	B
	5.0	A	B	B	B	B	B	C	C
	5.3	B	C	B	C	C	C	C	C
	5.6	C	C	C	C	C	C	D	D
Column 1	2	3	4	5	6	7	8	9	10

Legend - Stud Size and Spacing

A = 38 × 140 mm at 406 mm on centre
B = 38 × 140 mm at 305 mm on centre
C = two 38 × 140 mm studs at 406 mm on centre
D = two 38 × 140 mm studs at 305 mm on centre

Notes to Table A-33:

(1) A roof dead load of 0.5 kPa has been assumed. The Table does not apply where the stud supports additional loads from heavy roofing materials such as concrete tiles or clay roofing tiles.
(2) Wall construction shall conform to the requirements of Sentence 9.23.10.1.(2).

Table A-34
Minimum Number of 38 × 89 mm Spruce-Pine-Fir Stud Posts in Exterior Stud Walls Supporting Girder Trusses and Roof Beams(1)(2)(3)
Forming Part of Sentence 9.23.10.7.(2)

Stud Height, m	Span of Beam or Girder, m	Minimum Number of Studs																			
		Specified Roof Snow Load, kPa																			
		1.0				1.5				2.0				2.5				3.0			
		Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m			
		2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0
2.4	2.4	1	1	2	2	1	2	2	2	1	2	2	3	2	2	3	3	2	2	3	3
	3.6	1	2	2	2	2	2	3	3	2	2	3	4	2	3	4	4	2	3	4	5
	4.8	2	2	3	3	2	3	3	4	2	3	4	5	3	4	5		3	4	5	
	6.0	2	2	3	4	2	3	4	5	3	4	5		3	4			3	5		
	7.2	2	3	4	4	3	4	5		3	4			4	5			4			
	8.4	2	3	4	5	3	4	5		3	5			4				5			
	9.6	3	4	5		3	5			4				5				5			
	10.8	3	4	5		4	5			4				5							
	12.0	3	4			4				5											
3.0	2.4	1	2	2	2	2	2	3	3	2	2	3	4	2	3	4	4	2	3	4	5
	3.6	2	2	3	3	2	3	4	4	2	3	4	5	3	4	5		3	4		
	4.8	2	3	4	4	3	4	5		3	4			4	5			4			
	6.0	2	3	4	5	3	4			4	5			4				5			
	7.2	3	4	5		4	5			4				5							
	8.4	3	4			4				5											
	9.6	4	5			5															
	10.8	4				5															
	12.0	4																			
Col.1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Notes to Table A-34:

(1) A roof dead load of 0.62 kPa has been assumed.

(2) Roof beams require a minimum bearing length of 89 mm.

(3) Girder trusses require a minimum bearing length of 89 mm unless otherwise specified by the truss manufacturer.

Table A-35
Minimum Number of 38 × 140 mm Spruce-Pine-Fir Stud Posts in Exterior Stud Walls Supporting Girder Trusses and Roof Beams(1)(2)(3)
Forming Part of Sentence 9.23.10.7.(2)

Minimum Number of Studs																					
Stud Height, m	Span of Beam or Girder, m	Specified Roof Snow Load, kPa																			
		1.0				1.5				2.0				2.5				3.0			
		Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m			
		2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0
3.0	2.4	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	1	1	2	2
	3.6	1	1	1	1	1	1	2	2	1	1	2	2	1	2	2	2	1	2	2	3
	4.8	1	1	2	2	1	2	2	2	1	2	2	3	2	2	3	3	2	2	3	4
	6.0	1	1	2	2	1	2	2	3	2	2	3	3	2	2	3	4	2	3	4	4
	7.2	1	2	2	2	2	2	3	3	2	2	3	4	2	3	4	4	2	3	4	5
	8.4	1	2	2	3	2	2	3	4	2	3	4	4	2	3	4	5	3	4	5	
	9.6	2	2	3	3	2	3	3	4	2	3	4	5	3	4	5		3	4	5	
	10.8	2	2	3	3	2	3	4	4	2	3	4	5	3	4	5		3	5		
	12.0	2	2	3	4	2	3	4	5	3	4	5		3	4			4	5		
3.6	2.4	1	1	1	1	1	1	1	2	1	1	2	2	1	1	2	2	1	2	2	2
	3.6	1	1	1	2	1	1	2	2	1	2	2	3	1	2	2	3	2	2	3	3
	4.8	1	1	2	2	1	2	2	3	2	2	3	3	2	2	3	4	2	3	4	4
	6.0	1	2	2	3	2	2	3	3	2	3	3	4	2	3	4	5	2	3	4	5
	7.2	1	2	2	3	2	2	3	4	2	3	4	5	2	3	4	5	3	4	5	
	8.4	2	2	3	3	2	3	4	4	2	3	4	5	3	4	5		3	4		
	9.6	2	2	3	4	2	3	4	5	3	4	5		3	4			4	5		
	10.8	2	3	3	4	2	3	4	5	3	4	5		3	5			4			
	12.0	2	3	4	5	3	4	5		3	5			4	5			4			
Col. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Notes to Table A-35:

(1) A roof dead load of 0.62 kPa has been assumed.
(2) Roof beams require a minimum bearing length of 140 mm.
(3) Girder trusses require a minimum bearing length of 140 mm unless otherwise specified by the truss manufacturer.

Table A-36
Minimum Number of 38 × 89 mm Northern Species Stud Posts in Exterior Stud Walls Supporting Girder Trusses and Roof Beams(1)(2)(3)
Forming Part of Sentence 9.23.10.7.(2)

Stud Height, m	Span of Beam or Girder, m	Minimum Number of Studs																			
		Specified Roof Snow Load, kPa																			
		1.0				1.5				2.0				2.5				3.0			
		Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m			
		2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0
2.4	2.4	1	2	2	2	2	2	3	3	2	2	3	4	2	3	4	4	2	3	4	5
	3.6	2	2	3	3	2	3	4	4	2	3	4	5	3	4	5		3	4		
	4.8	2	3	4	4	3	4	5		3	4			4	5			4			
	6.0	2	3	4	5	3	4			4	5			4				5			
	7.2	3	4	5		4	5			4				5							
	8.4	3	4			4				5											
	9.6	4	5			5															
	10.8	4				5															
	12.0	4																			
3.0	2.4	2	2	3	3	2	3	3	4	2	3	4	5	3	4	5		3	4		
	3.6	2	3	4	5	3	4	5		3	5			4	5			4			
	4.8	3	4	5		3	5			4				5							
	6.0	3	5			4				5											
	7.2	4	5			5															
	8.4	4																			
	9.6	5																			
	10.8	5																			
	12.0																				
Col. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Notes to Table A-36:

(1) A roof dead load of 0.62 kPa has been assumed.
(2) Roof beams require a minimum bearing length of 89 mm.
(3) Girder trusses require a minimum bearing length of 89 mm unless otherwise specified by the truss manufacturer.

Table A-37
Minimum Number of 38 × 140 mm Northern Species Stud Posts in Exterior Stud Walls Supporting Girder Trusses and Roof Beams(1)(2)(3)
Forming Part of Sentence 9.23.10.7.(2)

Stud Height, m	Span of Beam or Girder, m	Minimum Number of Studs																			
		Specified Roof Snow Load, kPa																			
		1.0				1.5				2.0				2.5				3.0			
		Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m				Supported Length, m			
		2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0	2.4	3.6	4.8	6.0
3.0	2.4	1	1	1	1	1	1	2	2	1	1	2	2	1	2	2	2	1	2	2	3
	3.6	1	1	2	2	1	2	2	2	1	2	2	3	2	2	3	3	2	3	3	4
	4.8	1	2	2	2	2	2	3	3	2	2	3	4	2	3	4	4	2	3	4	5
	6.0	1	2	2	3	2	2	3	4	2	3	4	5	2	3	4	5	3	4	5	
	7.2	2	2	3	3	2	3	4	4	2	3	4	5	3	4	5		3	5		
	8.4	2	3	3	4	2	3	4	5	3	4	5		3	5			4	5		
	9.6	2	3	4	4	3	4	5		3	4			4	5			4			
	10.8	2	3	4	5	3	4	5		3	5			4				5			
	12.0	2	3	4	5	3	4			4	5			4				5			
3.6	2.4	1	1	1	2	1	1	2	2	1	2	2	3	1	2	2	3	2	2	3	3
	3.6	1	2	2	2	1	2	2	3	2	2	3	4	2	3	3	4	2	3	4	5
	4.8	1	2	2	3	2	2	3	4	2	3	4	5	2	3	4	5	3	4	5	
	6.0	2	2	3	4	2	3	4	5	3	4	5		3	4	5		3	5		
	7.2	2	3	3	4	2	3	4	5	3	4	5		3	5			4			
	8.4	2	3	4	5	3	4	5		3	5			4				4			
	9.6	2	3	4	5	3	4			4	5			4				5			
	10.8	3	4	5		3	5			4				5							
	12.0	3	4	5		4	5			5				5							
Col. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Notes to Table A-37:

(1) A roof dead load of 0.62 kPa has been assumed.

(2) Roof beams require a minimum bearing length of 140 mm.

(3) Girder trusses require a minimum bearing length of 140 mm unless otherwise specified by the truss manufacturer.

Part 12

Resource Conservation and Environmental Integrity

Section 12.1. General

12.1.1. Application

12.1.1.1. Scope

(1) The scope of this Part shall be as described in Subsection 1.1.2. of Division A.

12.1.1.2. Application

(1) This Part applies to resource conservation and environmental integrity in the design and *construction* of *buildings*.

Section 12.2. Energy Efficiency, Carbon Dioxide Equivalents and Peak Electric Demand

12.2.1. Energy Efficiency Design

12.2.1.1. Energy Efficiency Design Before January 1, 2017

(1) This Article applies to *construction* for which a permit has been applied for before January 1, 2017.

(3) Except as provided in Sentence (4), the energy efficiency of a *building* or part of a *building* of *residential occupancy* that is within the scope of Part 9 and is intended for occupancy on a continuing basis during the winter months shall,
(a) meet the performance level that is equal to a rating of 80 or more when evaluated in accordance with NRCan, "EnerGuide for New Houses: Administrative and Technical Procedures", or
(b) conform to Chapters 1 and 2 of MMAH Supplementary Standard SB-12, "Energy Efficiency for Housing".

(4) This Article does not apply to,
(b) a *building* that does not use electrical power or fossil fuel,
(c) a manufactured *building* described in Article 9.1.1.9., or
(d) a seasonal recreational *building* described in Section 9.36. or 9.38.

12.2.1.2. Energy Efficiency Design After December 31, 2016

(1) This Article applies to *construction* for which a permit has been applied for after December 31, 2016.

(2) Except as provided in Sentences (3) and (4), the energy efficiency of all *buildings* shall,
(a) be designed to exceed by not less than 13% the energy efficiency levels required by Sentence 12.2.1.1.(2), or
(b) conform to Division 1 and Division 3 or 5 of MMAH Supplementary Standard SB-10, "Energy Efficiency Requirements".

(3) Except as provided in Sentence (4), the energy efficiency of a *building* or part of a *building* of *residential occupancy* that is within the scope of Part 9 and is intended for occupancy on a continuing basis during the winter months shall,
(a) be designed to exceed by not less than 15% the energy efficiency levels required by Sentence 12.2.1.1.(3), or
(b) conform to Chapters 1 and 3 of MMAH Supplementary Standard SB-12, "Energy Efficiency for Housing".

(4) This Article does not apply to,
(a) a *farm building*,
(b) a *building* that does not use electrical power or fossil fuel,
(c) a manufactured *building* described in Article 9.1.1.9., or
(d) a seasonal recreational *building* described in Section 9.36. or 9.38.

Section 12.3. Energy Efficiency for Buildings of Residential Occupancy Within the Scope of Part 9

12.3.1. General

12.3.1.1. Application

(1) This Section applies to the energy efficiency of a *building* or part of a *building* of *residential occupancy* that is within the scope of Part 9 and is intended for occupancy on a continuing basis during the winter months.

12.3.1.2. Windows and Sliding Glass Doors

(1) The energy rating and the overall coefficient of heat transfer required for windows and sliding glass doors shall be determined in conformance with,
(a) CAN/CSA-A440.2, "Fenestration Energy Performance", or
(b) NFRC 100, "Procedure for Determining Fenestration Product U-factors" and NFRC 200, "Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence".

12.3.1.3. Temperature Control in Dwelling Units

(1) Except as provided in Sentence (3) and except where space heating energy is provided by a solid fuel-burning *appliance* or a ground source heat pump, the indoor air temperature in a *dwelling unit* shall be controlled by at least one programmable thermostatic control device.

(2) The programmable thermostatic control device required in Sentence (1) shall,
(a) allow the setting of different air temperatures for at least,
 (i) four time periods per day, and
 (ii) two different day-types per week,
(b) include a manual override, and
(c) allow the setting of the air temperature to,
 (i) 13°C or lower in heating mode, and
 (ii) 29°C or higher in cooling mode, where *air-conditioning* is provided.

(3) A manual thermostatic control device is permitted if it,
(a) controls a heating or cooling system where the heating or cooling capacity is not more than 2 kW, or
(b) serves an individual room or space.

12.3.1.4. Hot Water Piping Insulation

(1) Hot water pipes that are vertically connected to a hot water storage tank shall have heat traps on both inlet and outlet piping as close as practical to the tank, except where the tank,
(a) has an integral heat trap, or
(b) serves a recirculating system.

(2) The first 2.5 m of hot water outlet piping of a hot water storage tank serving a non-recirculating system shall be insulated to provide a thermal resistance of not less than RSI 0.62.

(3) The inlet pipe of a hot water storage tank between the heat trap and the tank serving a non-recirculating system shall be insulated to provide a thermal resistance of not less than RSI 0.62.

12.3.1.5. Residential Furnaces After December 31, 2014

(1) Sentence (2) applies to *construction* for which a permit has been applied for after December 31, 2014.

(2) A furnace serving a *dwelling unit* shall be equipped with a brushless direct current motor.

12.3.1.6. Energy Supply for Kitchen and Laundry Facilities After December 31, 2014

(1) This Article applies to *construction* for which a permit has been applied for after December 31, 2014.

(2) In order to supply energy to cooking appliances and clothes dryers, every kitchen and laundry space shall be provided with,
(a) an electrical outlet,
(b) a natural gas line, or
(c) a propane line.

Section 12.4. Water Efficiency

12.4.1. General

12.4.1.1. Plumbing Systems

(1) All *buildings* shall conform to the water efficiency requirements of Subsection 7.6.4.

7.6.4. Water Efficiency

7.6.4.1. Water Supply Fittings

(1) The flow rates of fittings that supply water to a *fixture* shall not exceed the maximum flow rates at the test pressures listed for that fitting in Table 7.6.4.1.

(2) Sentence (1) does not apply to a *fixture* located in a *heritage building.*

Table 7.6.4.1.
Maximum Flow Rates for Water Supply Fittings
Forming Part of Sentence 7.6.4.1.(1)

Fitting	Maximum Flow, L/min	Test Pressure, kPa
Lavatory Faucet	8.35	413
Kitchen Faucet	8.35	413
Shower Heads in Residential Occupancy	7.6	550
Shower Heads in Other Occupancies	9.5	550
Column 1	2	3

7.6.4.2. Plumbing Fixtures

(1) Water closets and urinals shall be certified to CAN/CSA-B45.0, "General Requirements for Plumbing Fixtures".

(2) Except as provided in Sentence (3), the flush cycle for each *fixture* that is a water closet or urinal shall not exceed the maximum water consumption per flush cycle listed for that *fixture* in Table 7.6.4.2.A. (See Appendix A.)

Table 7.6.4.2.A.
Maximum Water Consumption per Flush Cycle for Sanitary Fixtures
Forming Part of Sentence 7.6.4.2.(2)

Fixture	Maximum Water Consumption per Flush Cycle, LPF
Water Closet (Tank Type)	6.0
Water Closet (Direct Flush)	6.0
Urinal (Tank Type)	1.9(1)
Urinal (Direct Flush)	1.9(1)
Column 1	2

Notes to Table 7.6.4.2.A.:

(1) Urinals equipped with automatic flushing devices shall be controlled to prevent unnecessary flush cycles during building down time.

(3) In *buildings* classified as Group C *occupancy*, the flush cycle for each *fixture* that is a water closet or urinal shall not exceed the maximum water consumption per flush cycle listed for that *fixture* in Table 7.6.4.2.B.

(4) Sentences (2) and (3) do not apply to a *fixture* located in an existing *building* where the *chief building official* is satisfied that compliance with the requirement is impracticable because of maintenance or operational difficulties. (See Appendix A.)

Table 7.6.4.2.B.
Maximum Water Consumption per Flush Cycle for Sanitary Fixtures in a Group C Occupancy
Forming Part of Sentence 7.6.4.2.(3)

Fixture	Maximum Water Consumption per Flush Cycle, LPF
Water Closet (Tank Type)	4.8(1)
Water Closet (Direct Flush)	4.8
Urinal (Tank Type)	1.9(2)
Urinal (Direct Flush)	1.9(2)
Column 1	2

Notes to Table 7.6.4.2.B.:

(1) Water closets which provide a dual flush cycle option of both 4.1 LPF or less and 6.0 LPF are deemed to comply.

(2) Urinals equipped with automatic flushing devices shall be controlled to prevent unnecessary flush cycles during building down time.

Part 1

General

Section 1.1. Administration

1.1.1. Administration

1.1.1.1. Conformance with Administrative Requirements

(1) This Code shall be administered in conformance with the Act.

Section 1.2. Design and General Review

1.2.1. Design

1.2.1.1. Design (See Appendix A.)

(1) Where the *foundations* of a *building* are to be *constructed* below the level of the footings of an adjacent *building* and within the angle of repose of the *soil*, as drawn from the bottom of the footings, the *foundations* shall be designed by a suitably qualified and experienced person.

1.2.2. General Review

1.2.2.1. General Review by Architect or Professional Engineer (See Appendix A.)

(2) A person who intends to *construct* or have *constructed* a *building* or part of it required by Sentences (1) and (4) to (9) to be reviewed by an *architect*, *professional engineer* or both, shall ensure that an *architect*, *professional engineer* or both are retained to undertake the general review of the *construction* of the *building* in accordance with the performance standards of the Ontario Association of Architects or the Association of Professional Engineers of Ontario, as applicable, to determine whether the *construction* is in general conformity with the plans, sketches, drawings, graphic representations, specifications and other documents that form the basis for the issuance of a permit under section 8 of the Act or any changes to it authorized by the *chief building official.*

(3) The *architect*, *professional engineer* or both who have been retained to undertake the general review of the *construction* of a *building*, shall forward copies of written reports arising out of the general review to the *chief building official* or *registered code agency*, as the case may be.

(4) Where the *foundations* of a *building* are to be *constructed* below the level of the footings of an adjacent *building* and within the angle of repose of the *soil*, as drawn from the bottom of the footings, the *construction* of the *foundations* shall be reviewed by a *professional engineer.*

Section 1.3. Permits and Inspections

1.3.1. Permits

1.3.1.1. Requirement for Permits

(1) A person is exempt from the requirement to obtain a permit under section 8 of the Act,
(a) for the *demolition* of a *building* located on a farm,
(b) subject to Sentence (2), for the *construction* or *demolition* of a *building* in territory without municipal organization, or
(c) for the *construction* of a Class 1 *sewage system*.

(2) The exemption in Clause (1)(b) from the requirement to obtain a permit does not apply to the *construction* of a *sewage system* in territory without municipal organization.

1.3.1.2. Applications for Permits Under Section 8 of the Act

(1) An application for a permit under section 8 of the Act to *construct* or *demolish* a *building* shall be made by,
(a) the owner of the property on which the proposed *construction* or *demolition* is to take place, or
(b) the authorized agent of the owner referred to in Clause (a).

(2) An application referred to in Sentence (1) shall be in a form approved by the *Minister*.

(3) In Sentence (1),

"owner" includes, in respect of the property on which the *construction* or *demolition* will take place, the registered owner, a lessee and a mortgagee in possession.

1.3.1.3. Period Within Which a Permit is Issued or Refused

(1) Subject to Sentences (2) and (3) and unless the circumstances set out in Sentence (6) exist, if an application for a permit under subsection 8(1) of the Act that meets the requirements of Sentence (5) is submitted to a *chief building official*, the *chief building official* shall, within the time period set out in Column 2 of Table 1.3.1.3. corresponding to the class of *building* described in Column 1 of Table 1.3.1.3. for which the application is made,
(a) issue the permit, or
(b) refuse to issue the permit and provide in writing all of the reasons for the refusal.

(3) If an application for a permit under subsection 8(1) of the Act proposes *construction* or *demolition* of a *building* described in Sentence (4), the time period for the purposes of Sentence (1) shall be the longer of,
(a) 10 days, and
(b) the time period corresponding to the class of the *building* described in Column 1 of Table 1.3.1.3. that the *building* described in Sentence (4) serves, if any.

(4) A *building* referred to in Sentence (3) is,
(a) a structure occupying an area of 10 m^2 or less that contains *plumbing*, including the *plumbing* appurtenant to it,
(b) *plumbing* not located in a structure,
(c) a *sewage system*, or
(d) a structure designated in Article 1.3.1.1. of Division A.

(5) The requirements that an application for a permit under subsection 8(1) of the Act must meet for the purposes of Sentence (1) are,
(a) that the application is made in the form described in Sentence 1.3.1.2.(2),
(b) that the applicant for the permit is a person described in Clause 1.3.1.2.(1)(a) or (b),
(c) that all applicable fields on the application form and required schedules are completed,
(d) that all required schedules are submitted with the application,

(e) that payment is made of all fees that are required, under the applicable by-law, resolution or regulation made under clause 7(1)(c) of the Act, to be paid when the application is made, and
(f) that the applicant has declared in writing that,
(i) the application meets all the requirements set out in Clauses (a) to (e),
(ii) the application is accompanied by the plans and specifications prescribed by the applicable by-law, resolution or regulation made under clause 7(1)(b) of the Act,
(iii) the application is accompanied by the information and documents prescribed by the applicable by-law, resolution or regulation made under clause 7(1)(b) of the Act which enable the *chief building official* to determine whether the proposed *building*, *construction* or *demolition* will contravene any *applicable law*, and
(iv) the proposed *building*, *construction* or *demolition* will not contravene any *applicable law*.

(6) The *chief building official* is not required to make a decision within the time period required by Sentence (1) with respect to an application that meets the requirements of Sentence (5) if the *chief building official*,
(a) determines that,
(i) the application is not accompanied by the plans, specifications, information and documents referred to in Subclauses (5)(f)(ii) and (iii), or
(ii) the proposed *building*, *construction* or *demolition* will contravene any *applicable law*, and
(b) advises the applicant of his or her determination and provides in writing the reasons for the determination within two days.

(7) Subject to Sentences (9) and (10), the time period described in Sentences (1) to (3) and in Clause (6)(b) shall begin on the day following the day on which an application that meets the requirements of Sentence (5) is submitted to the *chief building official*.

(8) The time periods described in Column 2 of Table 1.3.1.3. and in Clause (6)(b) shall not include Saturdays, holidays and all other days when the offices of the *principal authority* are not open for the transaction of business with the public.

(9) The time period in Sentence (10) applies where,
(a) an application is made for the *construction* of a *building* that is served by a *sewage system*,
(b) *construction* is proposed in respect of the *sewage system* that serves the *building*, and
(c) a board of health, conservation authority, planning board or the council of an upper-tier municipality is responsible for the enforcement of the provisions of the Act and this Code related to the *sewage system* under section 3.1 of the Act or pursuant to an agreement under section 6.2 of the Act.

(10) The time period described in Sentences (1) to (3) and in Clause (6)(b) for an application referred to in Clause (9)(a) shall begin on the day following the later of,
(a) the day on which an application that meets the requirements of Sentence (5) is submitted to the *chief building official*, and
(b) the day on which a permit for the *construction* of the *sewage system* referred to in Clause (9)(b) is issued.

Table 1.3.1.3.
Period Within Which Permit Shall be Issued or Refused
Forming Part of Article 1.3.1.3.

Item	Class of Building	Time Period
1	(a) A detached house, semi-detached house, townhouse, or row house where no dwelling unit is located above another dwelling unit. (b) A detached structure that serves a building described in Clause (a) and does not exceed 55 m^2 in building area.	10 days
	Column 1	2

1.3.1.5. Conditional Permits

(1) The *chief building official* shall not issue a conditional permit for any stage of *construction* under subsection 8(3) of the Act unless compliance with the following applicable laws has been achieved in respect of the proposed *building* or *construction:*
(a) regulations made by a conservation authority under clause 28(1)(c) of the *Conservation Authorities Act* with respect to permission of the authority for the *construction* of a *building* or structure if, in the opinion of the authority, the control of flooding, erosion, dynamic beaches or pollution or the conservation of land may be affected by the development,
(b) section 5 of the *Environmental Assessment Act* with respect to the approval of the Minister or the Environmental Review Tribunal to proceed with an undertaking,
(c) subsection 24(3) of the *Niagara Escarpment Planning and Development Act*

(2) For the purposes of issuing a conditional permit under subsection 8(3) of the Act, a person is exempt from the requirement in clause 8(3)(a) of the Act of compliance with by-laws passed under sections 34 and 38 of the *Planning Act* where,
(a) a committee of adjustment has made a decision under section 45 of the *Planning Act* authorizing one or more minor variances from the provisions of any by-laws made under sections 34 and 38 of that Act,
(b) such minor variance or variances result in the achievement of full compliance with such by-laws, and
(c) no person informed the committee of adjustment of objections to the minor variances either in writing or in person at the hearing of the application.

(3) For the purposes of issuing a conditional permit under subsection 8(3) of the Act, a person is exempt from the requirement in clause 8(3)(a) of the Act of compliance with by-laws passed under sections 34 and 38 of the *Planning Act* where the *construction* in respect of which the conditional permit is issued is required in order to comply with an order issued under subsection 21(1) of the *Fire Protection and Prevention Act, 1997* or under subsection 15.9(4) of the Act.

(4) A permit issued under subsection 8(3) of the Act shall indicate its conditional nature.

1.3.1.6. Information to be Given to Tarion Warranty Corporation

(1) This Article prescribes, for the purposes of subsection 8(8.1) of the Act, the information relating to permits issued under section 8 of the Act and the applications for those permits that the *chief building official* is required to give to *Tarion Warranty Corporation* and the time within which the information is required to be given.

(2) The *chief building official* shall give the following information to *Tarion Warranty Corporation* with respect to permits issued under section 8 of the Act in respect of the *construction* of *buildings* described in Sentence (4),
(a) the dates the permits are issued and the numbers or other identifying symbols for the permits, and
(b) the information contained in the application forms submitted in respect of the permits, other than the information contained in the schedules or other attachments to the application forms.

(3) Despite Sentence (2), the *chief building official* is not required to give to *Tarion Warranty Corporation* information which relates to the extension or material alteration or repair of an existing *building*.

(4) The *buildings* referred to in Sentence (2) are any *building* whose proposed use is classified as a Group C *major occupancy* and which is not a *boarding, lodging or rooming house* or a *building* containing a *hotel*.

(5) The *chief building official* shall give the information described in Sentence (2) within 45 days after the day on which the permits to which the information relates are issued.

(6) The time period described in Sentence (5) shall not include Saturdays, holidays and all other days when the offices of the *principal authority* are not open for the transaction of business with the public.

1.3.2. Site Documents

1.3.2.1. Permit Posting

(1) Where a permit has been issued pursuant to the Act, the person to whom it is issued shall have the permit or a copy of it posted at all times during *construction* or *demolition* in a conspicuous place on the property in respect of which the permit was issued.

1.3.2.2. Documentation on Site

(1) The person in charge of the *construction* of the *building* shall keep and maintain on the site of the *construction*,

(a) at least one copy of drawings and specifications certified by the *chief building official* or a person designated by the *chief building official* to be a copy of those submitted with the application for the permit to *construct* the *building*, together with changes that are authorized by the *chief building official* or a person designated by the *chief building official*,

(b) copies of authorizations of the Building Materials Evaluation Commission on the basis of which the permit was issued, and

(c) copies of rulings of the *Minister*, made under clause 29(1)(a) or (c) of the Act, on the basis of which the permit was issued.

1.3.3. Occupancy of Buildings

1.3.3.2. Conditions for Residential Occupancy

(1) A person may occupy or permit to be occupied a *building* intended for *residential occupancy* that has not been fully completed at the date of occupation provided that,

(a) the *building*,
   - (i) is of three or fewer *storeys* in *building height* and has a *building area* not exceeding 600 m^2,
   - (ii) has not more than 1 *dwelling unit* above another *dwelling unit*,
   - (iii) has not more than 2 *dwelling units* sharing a common *means of egress*, and
   - (iv) has no accommodation for tourists,

(b) the following *building* components and systems are complete, operational and inspected:
   - (i) required *exits*, handrails and *guards*, fire alarm and detection systems, and *fire separations*,
   - (ii) required exhaust fume barriers and self-closing devices on doors between an attached or built-in garage and a *dwelling unit*,
   - (iii) water supply, sewage disposal, lighting and heating systems, and
   - (iv) protection of foamed plastics required by Article 9.10.17.10. of Division B,

(c) the following *building* components and systems are complete, operational, inspected and tested:
   - (i) *water systems*,
   - (ii) *building drains* and *building sewers*, and
   - (iii) *drainage systems* and *venting systems*, and

(d) where applicable, the *building* conforms to Article 9.1.1.7. of Division B.

(2) Sentence (1) does not apply in respect of the occupancy of a *building* to which Article 1.3.3.4. applies.

1.3.3.3. Notification

(1) Where a person has occupied or permitted the occupancy of a *building* under Article 1.3.3.1. or 1.3.3.2., such person shall notify the *chief building official* forthwith upon completion of the *building*.

1.3.3.4. Occupancy Permit — Certain Buildings of Residential Occupancy

(1) No person shall occupy or permit to be occupied a *building* described in Sentence (3), or part of it, unless the *chief building official* or a person designated by the *chief building official* has issued a permit authorizing occupation of the *building* or part of it in accordance with Sentence (4).

(2) This Article does not apply in respect of the *occupancy* of an existing *building*, or part of it, that has been subject to extension or material alteration or repair.

(3) A *building* referred to in Sentence (1) is a *building* intended for *residential occupancy* that,
(a) is of three or fewer *storeys* in *building height* and has a *building area* not exceeding 600 m^2,
(b) has no accommodation for tourists,
(c) does not have a *dwelling unit* above another *dwelling unit*, and
(d) does not have any *dwelling units* sharing a common *means of egress*.

(4) The *chief building official* or a person designated by the *chief building official* shall issue a permit authorizing occupation of a *building* described in Sentence (3), where,
(a) the structure of the *building* with respect to the *dwelling unit* to be occupied is substantially complete and ready to be used for its intended purpose,
(b) the *building* envelope, including, but not limited to, cladding, roofing, windows, doors, assemblies requiring *fire-resistance ratings*, *closures*, insulation, *vapour barriers* and air barriers, with respect to the *dwelling unit* to be occupied, is substantially complete,
(c) the walls enclosing the *dwelling unit* to be occupied conform to Sentence 9.25.2.3.(7) of Division B,
(d) required electrical supply is provided for the *dwelling unit* to be occupied,
(e) required firefighting access routes to the *building* have been provided and are accessible,
(f) the following *building* components and systems are complete and operational for the *dwelling unit* to be occupied:
  (i) required *exits*, floor access and egress systems, handrails, *guards*, *smoke alarms*, carbon monoxide alarms and *fire separations*, including, but not limited to, fire stopping,
  (ii) required exhaust fume barriers and self-closing devices on doors between an attached or built-in garage and the *dwelling unit*,
  (iii) water supply, sewage disposal, lighting and heating systems, and
  (iv) protection of foamed plastics required by Article 9.10.17.10. of Division B,
(g) the following *building* components and systems are complete, operational and tested for the *dwelling unit* to be occupied:
  (i) *water system*,
  (ii) *building drain* and *building sewer*, and
  (iii) *drainage system* and *venting system*,
(h) required *plumbing fixtures* in the *dwelling unit* to be occupied are substantially complete and operational, and
(i) where applicable, the *building* conforms to Article 9.1.1.7. of Division B with respect to the *dwelling unit* to be occupied.

1.3.4. Fire Department Inspection

1.3.4.1. Fire Department Approval

(1) Subject to Sentence (2), if the council of a *municipality* assigns specific responsibility for the enforcement of any portion of this Code respecting fire safety matters to an *inspector* who is the chief of the fire department of the *municipality*, the *chief building official* shall not issue a permit to *construct* a *building* unless the *inspector* approves the drawings submitted with the application for the permit as complying with that portion of this Code.

(2) If a *registered code agency* has been appointed under clause 4.1(4)(a) or (c) of the Act,
(a) a *municipality* shall not assign responsibility under Sentence (1) to the chief of the fire department with respect to a *building* for which the *registered code agency* has been appointed, and
(b) any assignment of responsibility under Sentence (1) with respect to a *building* for which the *registered code agency* is appointed shall be cancelled as of the date of the appointment.

1.3.5. Notices and Inspections

1.3.5.1. Prescribed Notices

(1) This Article sets out the notices that are required under section 10.2 of the Act.

(2) The person to whom a permit under section 8 of the Act is issued shall notify the *chief building official* or, where a *registered code agency* is appointed under the Act in respect of the *construction* to which the notice relates, the *registered code agency* of,
(a) readiness to *construct* footings,
(b) substantial completion of footings and *foundations* prior to commencement of backfilling,
(c) substantial completion of structural framing and ductwork and piping for heating and *air-conditioning* systems, if the *building* is within the scope of Part 9 of Division B,
(d) substantial completion of structural framing and roughing-in of heating, ventilation, *air-conditioning* and air-contaminant extraction equipment, if the *building* is not a *building* to which Clause (c) applies,
(e) substantial completion of insulation and *vapour barriers*,
(f) substantial completion of *air barrier systems*,
(g) substantial completion of all required *fire separations* and *closures* and all fire protection systems including standpipe, sprinkler, fire alarm and emergency lighting systems,
(h) substantial completion of fire access routes,
(i) readiness for inspection and testing of,
  (i) *building sewers* and *building drains*,
  (ii) *water service pipes*,
  (iii) *fire service mains*,
  (iv) *drainage systems* and *venting systems*,
  (v) the *water distribution system*, and
  (vi) *plumbing* fixtures and *plumbing* appliances,
(l) readiness to *construct* the *sewage system*,
(m) substantial completion of the installation of the *sewage system* before the commencement of backfilling,
(n) substantial completion of installation of *plumbing* not located in a structure, before the commencement of backfilling,
(o) completion of *construction* and installation of components required to permit the issue of an occupancy permit under Sentence 1.3.3.1.(3) or to permit occupancy under Sentence 1.3.3.2.(1), if the *building* or part of the *building* to be occupied is not fully completed, and
(p) completion of *construction* and installation of components required to permit the issue of an occupancy permit under Sentence 1.3.3.4.(4).

1.3.5.2. Additional Notices

(1) A by-law, resolution or regulation made by a *principal authority* under clause 7(1)(e) of the Act may require that notice of one or more of the following stages of *construction* be given by the person to whom a permit is issued under section 8 of the Act:
(a) commencement of *construction* of the *building*,
(b) substantial completion of structural framing for each *storey*, if the *building* is a type of *building* that is within the scope of Division B, other than Part 9,
(c) commencement of *construction* of,
  (i) masonry fireplaces and masonry *chimneys*,
  (ii) factory-built fireplaces and allied *chimneys*, or
  (iii) *stoves*, ranges, *space heaters* and add-on *furnaces* using solid fuels and allied *chimneys*,

(d) substantial completion of interior finishes,
(e) substantial completion of heating, ventilating, *air-conditioning* and air-contaminant extraction equipment,
(f) substantial completion of exterior cladding,
(g) substantial completion of site grading,
(h) substantial completion of the pool deck and dressing rooms for a *public pool* or *public spa* and readiness for inspection of the emergency stop system for a *public pool* or *public spa*,
(i) completion and availability of drawings of the *building* as constructed, and
(j) completion of a *building* for which an occupancy permit is required under Article 1.3.3.4.

1.3.5.3. Prescribed Inspections

(1) Except as provided in Sentence (2), an *inspector* or *registered code agency*, as the case may be, shall, not later than two days after receipt of a notice given under Sentence 1.3.5.1.(2), undertake a site inspection of the *building* to which the notice relates.

(2) Where a notice given under Sentence 1.3.5.1.(2) relates to matters described in Clause 1.3.5.1.(2)(l) or (m), an *inspector* or *registered code agency*, as the case may be, shall, not later than five days after receipt of the notice, undertake a site inspection of the *sewage system* to which the notice relates.

(3) When undertaking an inspection required under Sentence (1) or (2), the *inspector* or *registered code agency*, as the case may be, may consider reports concerning whether the *building* or a part of the *building* complies with the Act or this Code.

(4) The time periods referred to in Sentences (1) and (2) shall begin on the day following the day on which the notice is given.

(5) The time periods referred to in Sentences (1) and (2) shall not include Saturdays, holidays and all other days when the offices of the *principal authority* are not open for the transaction of business with the public.

1.3.5.4. Construction of Sewage Systems

(1) The following information is prescribed for the purposes of subsection 15.12(3) of the Act and must be provided to the *chief building official* before the commencement of the *construction* of a *sewage system*:
(a) the information described in Sentence 3.3.4.1.(2) as it relates to,
  (i) the person registered under Article 3.3.3.2., and
  (ii) the person with the qualifications described in Clause 3.3.3.2.(1)(a) who will supervise *construction* on-site of the *sewage system*, and
(b) the name and telephone number of the representative of the person described in Subclause (a)(i) who may be contacted by the *chief building official* in respect of the *construction* of the *sewage system*.

1.3.5.5. Orders

(1) An order issued under subsection 12(2), 13(1) or (6), 14(1) or 15.10.1(2) or clause 18(1)(f) of the Act shall be in a form approved by the *Minister*.

1.3.6. As Constructed Plans

1.3.6.1. Application (See Appendix A.)

(1) Where a by-law, resolution or regulation has been made by a *principal authority* under clause 7(1)(g) of the Act, the *chief building official* may require that *as constructed plans* for the whole of, or any part or system of, a *building* or any class of *buildings* be provided by the persons responsible for the *construction*.

Section 1.4. Search Warrant

1.4.1. Forms

1.4.1.1. Information & Warrant Forms

(1) An information to obtain a warrant to enter and search a *building*, receptacle or place under subsection 21(1) of the Act shall be in Form 1.4.1.1.A.

(2) A warrant to enter and search a *building*, receptacle or place under subsection 21(1) of the Act shall be in Form 1.4.1.1.B.

FORM 1.4.1.1.A.
INFORMATION TO OBTAIN SEARCH WARRANT UNDER SECTION 21 OF THE BUILDING CODE ACT, 1992

Building Code Act, 1992

ONTARIO COURT OF JUSTICE
PROVINCE OF ONTARIO

This is the information of ______________________________
(name)

of ______________________, ______________________.
(address) (occupation)

I have reasonable ground to believe and do believe that the offence of ______________________

______________________ contrary to *Building Code Act, 1992*

Section ____________ has been committed and that the entry into and search of a certain building, receptacle or place, namely,

____
(building, receptacle or place)

____

of ______________________, at ______________________
(owner) (address)

will afford the following evidence: ______________________

____
(describe evidence to be searched for, including things to be seized, if any)

relevant to the commission of the offence.

And I further say that my grounds for so believing are:

____

____

Therefore, I request that a search warrant be issued to

Check appropriate box

☐ enter into and search the said ______________________
(building, receptacle or place)
______________________ for the said evidence.

☐ enter into and search the said ______________________
(building, receptacle or place)
______________________ for the said evidence and to seize the following things: ______________________
(describe things to be seized)

____
Informant

Sworn before me at ______________________,

this ________ day of ______________, ________

____
Provincial Judge or Justice of the Peace in and for the Province of Ontario

FORM 1.4.1.1.B.
SEARCH WARRANT UNDER SECTION 21 OF THE BUILDING CODE ACT, 1992

Building Code Act, 1992

ONTARIO COURT OF JUSTICE
PROVINCE OF ONTARIO

To: ______________________________,

Whereas, on the information on oath of ______________________, I am satisfied that there is reasonable ground to believe that the offence of ______________________

contrary to *Building Code Act, 1992* Section ______________________ has been committed and that

____
(describe evidence to be searched for, including things to be seized, if any)
____

that there is reasonable ground to believe will afford evidence of the said offence may be found

at ______________________________

____
(building, receptacle or place)

of ______________________ (owner), at ______________________ (address)

hereinafter called the premises.

This is therefore to authorize you to enter such ______________________

____
(name or location of building, receptacle or place)

between the hours of 6:00 a.m. and 9:00 p.m., or ______________________
(time warrant to be executed)

Check appropriate box

☐ and to search for the said evidence.

☐ and to search for the said evidence and to seize the following things: ______________________
(describe things to be seized)

and carry them before me or another Provincial Judge or Justice of the Peace so that they may be dealt with according to the law.

This warrant expires on the _______ day of ______________, __________, a day not later than the fifteenth day after its issue.

Issued at ______________________,

this _______ day of ______________, ________

____
Provincial Judge or Justice of the Peace in and for the Province of Ontario

Part 2

Alternative Solutions, Disputes, Rulings and Interpretations

Section 2.1. Alternative Solutions

2.1.1. Documentation of Alternative Solutions

2.1.1.1. Documentation

(1) The person proposing the use of an *alternative solution* shall provide documentation to the *chief building official* or *registered code agency that*,
(a) identifies applicable *objectives*, *functional statements* and *acceptable solutions*, and
(b) establishes on the basis of past performance, tests described in Article 2.1.1.2. or other evaluation that the proposed *alternative solution* will achieve the level of performance required under Article 1.2.1.1. of Division A.

(2) The documentation described in Sentence (1) shall include information about relevant assumptions, limiting or restricting factors, testing procedures, studies or *building* performance parameters, including any commissioning, operational and maintenance requirements.

2.1.1.2. Tests

(1) Where no published test method to establish the suitability of an *alternative solution* proposed under Article 2.1.1.1. exists, then the tests used for the purposes of that Article shall be designed to simulate or exceed anticipated service conditions or shall be designed to compare the performance of the material or system with a similar material or system that is known to be acceptable.

(2) The results of tests or evaluations based on test standards, other than as described in this Code, may be used for the purposes of Sentence (1), if the alternate test standards provide comparable results.

Section 2.2. Building Code Commission

2.2.1. Hearings

2.2.1.1. Divisions

(1) The Building Code Commission may sit in two or more divisions simultaneously so long as a quorum of each division is present.

2.2.1.2. Single Member

(1) One member of the Building Code Commission may, with the approval of the chair or vice-chair, hear and determine any dispute set out in Sentence (2) and, for that purpose, the member has all the jurisdiction and powers of the Commission.

(2) The disputes referred to in Sentence (1) are,
(a) any dispute described in clause 24(1)(a) of the Act respecting the sufficiency of compliance with technical requirements of this Code related to *sewage systems*, and
(b) any dispute described in clause 24(1)(b) or (c) of the Act.

2.2.1.3. Time Period

(1) A hearing to decide a dispute described in Clause 2.2.1.2.(2)(b) shall be held not more than five days after the Commission receives an application for a hearing in a form approved by the Commission.

(2) The time period described in Sentence (1) commences on the day after the Commission receives the application and excludes Saturdays, holidays and all other days when the offices of the Government of Ontario are not open for the transaction of business with the public.

2.2.1.4. Eligibility

(1) The following relationships to a *registered code agency* are prescribed for the purposes of clause 23(3)(d) of the Act as relationships to a *registered code agency* that make a person ineligible to be a member of the Commission:
(a) the person is registered under Article 3.4.3.2. as a *registered code agency*,
(b) the person is an officer, director, partner or employee of a *registered code agency*, or
(c) the person is engaged by a *registered code agency* to perform functions under the Act on behalf of the *registered code agency*.

2.2.1.5. Application Fee

(1) The fee on an application to the Building Code Commission under subsection 24(1.1) of the Act is,
(a) $170, for 2014, and
(b) the amount determined in accordance with Sentences (2) and (3) rounded to the nearest dollar, for 2015 and subsequent calendar years.

(2) On and after January 1, 2015, the fee for a calendar year is the fee for the previous calendar year adjusted by the percentage change from year to year in the Consumer Price Index for Ontario (All-Items) as reported monthly by Statistics Canada under the authority of the *Statistics Act* (Canada), averaged over the 12-month period that ends on March 31 of the previous calendar year, rounded to the first decimal point.

(3) Despite Sentence (2), if the percentage change results in a negative amount, the fee for a calendar year shall remain at the same level as the previous calendar year.

Section 2.3. Building Materials Evaluation Commission

2.3.1. Application Fee

2.3.1.1. Application Fee

(1) The fee on an application to the Building Materials Evaluation Commission is $950.00.

Section 2.4. Rulings and Interpretations

2.4.1. Minister's Rulings — Innovative Materials, Systems or Building Designs

2.4.1.1. Designated Materials Evaluation Bodies

(1) The following body is designated as a materials evaluation body for the purposes of clause 29(1)(a) of the Act: Canadian Construction Materials Centre of the National Research Council of Canada.

2.4.1.2. Fee

(1) The fee on a request for a ruling under clause 29(1)(a) of the Act is,
(a) $560, for 2014, and
(b) the amount determined in accordance with Sentences (2) and (3) rounded to the nearest dollar, for 2015 and subsequent calendar years.

(2) On and after January 1, 2015, the fee for a calendar year is the fee for the previous calendar year adjusted by the percentage change from year to year in the Consumer Price Index for Ontario (All-Items) as reported monthly by Statistics Canada under the authority of the *Statistics Act* (Canada), averaged over the 12-month period that ends on March 31 of the previous calendar year, rounded to the first decimal point.

(3) Despite Sentence (2), if the percentage change results in a negative amount, the fee for a calendar year shall remain at the same level as the previous calendar year.

2.4.2. Minister's Rulings — Alternative Materials, Systems or Building Designs

2.4.2.1. Criteria

(1) Sentence (2) sets out criteria to be followed by the *Minister* when making a ruling under clause 29(1)(c) of the Act to approve the use of an alternative material, system or *building* design.

(2) The *Minister's* approval of the use of an alternative material, system or *building* design referred to in Sentence (1) may be granted only if the approval is consistent with,
(a) a decision of the Building Code Commission in respect of a dispute described in clause 24(1)(a) of the Act,
(b) an approval of the use of the material, system or *building* design in the whole of another province or territory in accordance with the law of that province or territory, or
(c) a revision of the CCBFC NRCC 53301, "National Building Code of Canada", or the CCBFC NRCC 53302, "National Plumbing Code of Canada", that has been approved by the Canadian Commission on Building and Fire Codes.

2.4.3. Interpretations By Minister

2.4.3.1. Interpretations By Minister

(1) Every interpretation issued by the *Minister* under section 28.1 of the Act shall be made available to the public,
(a) by posting the interpretation on the *Building Code website*, and
(b) by providing a written copy of the interpretation on receipt of a request for it.

Part 4

Transition, Amendments, Revocation and Commencement

Section 4.1. Transition Rule

4.1.1. Transition, January 2014

4.1.1.1. Transition Rule

(1) Subject to Sentence (2), Ontario Regulation 350/06 (Building Code) made under the Act, as it read on December 31, 2013, is deemed to continue in force with respect to *construction* for which a permit has been applied for before January 1, 2014.

(2) Sentence (1) does not apply unless the *construction* is commenced within six months after the permit is issued.

4.1.2. Transition, January 2015

4.1.2.1. Transition Rule

(1) Subject to Sentence (2), this Regulation, as it read on December 31, 2014, is deemed to continue in force with respect to *construction* for which a permit has been applied for before January 1, 2015.

(2) Sentence (1) does not apply unless the *construction* is commenced within six months after the permit is issued.

Section 4.3. Revocation

4.3.1. Revocation

4.3.1.1. Revocation

(1) Ontario Regulation 350/06 is revoked.

Section 4.4. Commencement

4.4.1. Commencement

4.4.1.1. Effective Dates

(1) Subject to Sentences (2) and (3), this Regulation comes into force on January 1, 2014.

SB-1 Climatic and Seismic Data

Introduction

The great diversity of climate in Ontario has a considerable effect on the performance of buildings; consequently, building design must reflect this diversity. This Supplementary Standard briefly describes how climatic design values are computed and provides recommended design data for a number of cities, towns, and lesser populated locations. Through the use of such data, appropriate allowances can be made for climate variations in different localities of Ontario and the 2012 Building Code can be applied provincially.

The climatic design data provided in this Supplementary Standard are based on weather observations collected by the Atmospheric Environment Service, Environment Canada. The climatic design data have been researched and analyzed for the Canadian Commission on Building and Fire Codes by Environment Canada, and appear at the end of this Supplementary Standard in Table 1.2, Design Data for Selected Locations in Ontario.

As it is not practical to list values for all municipalities in Ontario, recommended climatic design values for locations not listed can be obtained by contacting the Atmospheric Environment Service, Environment Canada, 4905 Dufferin Street, Downsview, Ontario M3H 5T4, (416) 739-4365. It should be noted, however, that these recommended values may differ from the values accepted by municipal building authorities based on local experience.

The information on seismic hazard in spectral format has been provided by the Geological Survey of Canada of Natural Resources Canada. Information for municipalities not listed may be obtained through the Natural Resources Canada Web site at www.EarthquakesCanada.ca, or by writing to the Geological Survey of Canada at 7 Observatory Crescent, Ottawa, Ontario KIA OY3, or at P.O. Box 6000, Sidney, B.C. V8L 4B2.

General

The choice of climatic elements tabulated in this Supplementary Standard and the form in which they are expressed have been dictated largely by the requirements for specific values in several sections of the 2012 Building Code. These elements include the Ground Snow Loads, Wind Pressures, Design Temperatures, Heating Degree-Days, One-Day and 15-Minute Rainfalls, the Annual Total Precipitation values and Seismic Data. The following notes briefly explain the significance of these particular elements in building design, and indicate which weather observations were used and how they were analyzed to yield the required design values.

In Table 1.2, Design Data for Selected Locations in Ontario, design weather recommendations and elevations are listed for over 230 locations, which have been chosen based on a variety of reasons. Many incorporated cities and towns with significant populations are included unless located close to larger cities. For sparsely populated areas, many smaller towns and villages are listed. Other locations have been added to the list when the demand for climatic design recommendations at these sites has been significant. The named locations refer to the specific latitude and longitude defined by the Gazetteer of Canada (Natural Resources Canada), available from Publishing and Depository Services Canada, Public Works and Government Services Canada, Ottawa, Ontario KIA OS5. The elevations are given in metres and refer to heights above sea level.

Almost all of the weather observations used in preparing Table 1.2 were, of necessity, observed at inhabited locations. To estimate design values for arbitrary locations, the observed or computed values for the weather stations were mapped and interpolated appropriately. Where possible, adjustments have been applied for the influence of elevation and known topographical effects. Such influences include the tendency of cold air to collect in depressions, for precipitation to increase with elevation, and for generally stronger winds near large bodies of water. Elevations have been added to the Table because of their potential to significantly influence climatic design values.

Since interpolation from the values in Table 1.2 to other locations may not be valid due to local and other effects, Environment Canada will provide climatic design element recommendations for locations not listed in Table 1.2. Local effects are particularly significant in mountainous areas, where the values apply only to populated valleys and not to the mountain slopes and high passes, where very different conditions are known to exist.

Changing and Variable Climates

Climate is not static. At any location, weather and climatic conditions vary from season to season, year to year, and over longer time periods (climate cycles). This has always been the case. Evidence is mounting that the climates of Ontario are changing and will continue to change significantly in the future. When estimating climatic design loads, this variability can be considered using appropriate statistical analysis, data records spanning sufficient periods, and meteorological judgement. The analysis generally assumes that the past climate will be representative of the future climate.

Past and ongoing modifications to atmospheric chemistry (from greenhouse gas emissions and land use changes) are expected to alter most climatic regimes in the future despite the success of the most ambitious greenhouse gas mitigation plans.[10] Some regions could see an increase in the frequency and intensity of many weather extremes, which will accelerate weathering processes. Consequently, many buildings will need to be designed, maintained and operated to adequately withstand ever changing climatic loads.

Similar to global trends, the last decade in Canada was noted as the warmest in instrumented record. Canada has warmed, on average, at almost twice the rate of the global average increase, while the western Arctic is warming at a rate that is unprecedented over the past 400 years.[10] Mounting evidence from Arctic communities indicates that rapid changes to climate in the North have resulted in melting permafrost and impacts from other climate changes have affected nearly every type of built structure. Furthermore, analyses of Canadian precipitation data shows that many regions of the country have, on average, also been tending towards wetter conditions.[10] In the United States, where the density of climate monitoring stations is greater, a number of studies have found an unambiguous upward trend in the frequency of heavy to extreme precipitation events, with these increases coincident with a general upward trend in the total amount of precipitation. Climate change model results, based on an ensemble of global climate models worldwide, project that future climate warming rates will be greatest in higher latitude countries such as Canada.[11]

January Design Temperatures

A building and its heating system should be designed to maintain the inside temperature at some pre-determined level. To achieve this, it is necessary to know the most severe weather conditions under which the system will be expected to function satisfactorily. Failure to maintain the inside temperature at the pre-determined level will not usually be serious if the temperature drop is not great and if the duration is not long. The outside conditions used for design should, therefore, not be the most severe in many years, but should be the somewhat less severe conditions that are occasionally but not greatly exceeded.

The January design temperatures are based on an analysis of January air temperatures only. Wind and solar radiation also affect the inside temperature of most buildings and may need to be considered for energy-efficient design.

The January design temperature is defined as the lowest temperature at or below which only a certain small percentage of the hourly outside air temperatures in January occur. In the past, stations with records from all or part of the period

1951-66 formed the basis for calculation of the 2.5 and 1% January temperatures. Where necessary, the data were adjusted for consistency. Since most of the temperatures were observed at airports, design values for the core areas of large cities could be 1 or 2°C milder, although the values for the fringe areas are probably about the same as for the airports. No adjustments were made for this urban heat island effect. The design values for the next 20 to 30 years will probably differ from these tabulated values due to year-to-year climate variability and global climate change resulting from the impact of human on atmospheric chemistry.

The design temperatures were reviewed and updated using hourly temperature observations from stations for a 25-year period up to 2006 with at least 8 years of complete data. These data are consistent with data shown for Canadian locations in the 2009 Handbook of Fundamentals[12] published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). The most recent 25 years of record were used to provide a balance between accounting for trends in the climate and the sampling variation owing to year-to-year variation. The 1% and 2.5% values used for the design conditions represent percentiles of the cumulative frequency distribution of hourly temperatures and correspond to January temperatures that are colder for 8 and 19 hours, respectively, on average over the long term.

The 2.5% January design temperature is the value ordinarily used in the design of heating systems. In special cases, when the control of inside temperature is more critical, the 1% value may be used. Other temperature-dependent climatic design parameters may be considered for future issues of this document.

July Design Temperatures

A building and its cooling and dehumidifying system should be designed to maintain the inside temperature and humidity at certain pre-determined levels. To achieve this, it is necessary to know the most severe weather conditions under which the system is expected to function satisfactorily. Failure to maintain the inside temperature and humidity at the pre-determined levels will usually not be serious if the increases in temperature and humidity are not great and the duration is not long. The outside conditions used for design should, therefore, not be the most severe in many years, but should be the somewhat less severe conditions that are occasionally but not greatly exceeded.

The summer design temperatures in this Supplementary Standard are based on an analysis of July air temperatures and humidities. Wind and solar radiation also affect the inside temperature of most buildings and may, in some cases, be more important than the outside air temperature. More complete summer and winter design information can be obtained from Environment Canada.

The July design dry-bulb and wet-bulb temperatures were reviewed and updated using hourly temperature observations from stations for a 25-year period up to 2006. These data are consistent with data shown for Canadian locations in the 2009 Handbook of Fundamentals(12) published by ASHRAE. As with January design temperatures, data from the most recent 25-year period were analyzed to reflect any recent climatic changes or variations. The 2.5% values used for the dry- and wet-bulb design conditions represent percentiles of the cumulative frequency distribution of hourly dry- and wet-bulb temperatures and correspond to July temperatures that are higher for 19 hours on average over the long term.

Heating Degree-Days

The rate of consumption of fuel or energy required to keep the interior of a small building at 21°C when the outside air temperature is below 18°C is roughly proportional to the difference between 18°C and the outside temperature. Wind speed, solar radiation, the extent to which the building is exposed to these elements and the internal heat sources also affect the heat required and may have to be considered for energy-efficient design. For average conditions of wind, radiation, exposure, and internal sources, however, the proportionality with the temperature difference generally still holds.

Since the fuel required is also proportional to the duration of the cold weather, a convenient method of combining these elements of temperature and time is to add the differences between 18°C and the mean temperature for every day in the year when the mean temperature is below 18°C. It is assumed that no heat is required when the mean outside air temperature for the day is 18°C or higher.

Although more sophisticated computer simulations using other forms of weather data have now almost completely replaced degree-day-based calculation methods for estimating annual heating energy consumption, degree-days remain a useful indicator of relative severity of climate and can form the basis for certain climate-related code requirements.

The degree-days below 18°C were compiled for stations for the 25-year period ending in 2006. This analysis period is consistent with the one used to derive the design temperatures described above and with the approach used by ASHRAE.(12)

A difference of only one Celsius degree in the mean annual temperature will cause a difference of 250 to 350 in the Celsius degree-days. Since differences of 0.5 of a Celsius degree in the mean annual temperature are quite likely to occur between two stations in the same town, heating degree-days cannot be relied on to an accuracy of less than about 100 degree-days.

Heating degree-day values for the core areas of larger cities can be 200 to 400 degree-days less (warmer) than for the surrounding fringe areas. The observed degree-days, which are based on daily temperature observations, are often most representative of rural settings or the fringe areas of cities.

Climatic Data for Energy Consumption Calculations

The climatic elements tabulated in this Supplementary Standard represent commonly used design values but do not include detailed climatic profiles, such as hourly weather data. Where hourly values of weather data are needed for the purpose of simulating the annual energy consumption of a building, they can be obtained from multiple sources, such as Environment Canada, Natural Resources Canada, the Regional Conservation Authority and other such public agencies that record this information. Hourly weather data are also available from public and private agencies that format this information for use with annual energy consumption simulation software; in some cases, these data have been incorporated into the software.

Snow Loads

The roof of a building should be able to support the greatest weight of snow that is likely to accumulate on it in many years. Some observations of snow on roofs have been made in Canada, but not enough to form the basis for estimating roof snow loads throughout the country. Similarly, observations of the weight, or water equivalent, of the snow on the ground have not been available in digital form in the past. The observations of roof loads and water equivalents are very useful, as noted below, but the measured depth of snow on the ground is used to provide the basic information for a consistent set of snow loads.

The estimation of the design snow load on a roof from snow depth observations involves the following steps:

1. The depth of snow on the ground, which has an annual probability of exceedance of 1-in-50, is computed.
2. The appropriate unit weight is selected and used to convert snow depth to loads, S_s.
3. The load, S_r, which is due to rain falling on the snow, is computed.
4. Because the accumulation of snow on roofs is often different from that on the ground, adjustments are applied to the ground snow load to provide a design snow load on a roof.

The annual maximum depth of snow on the ground has been assembled from stations for which data has been recorded by the Atmospheric Environment Service (AES). The period of record used varied from station to station, ranging from 7 to 38 years. These data were analyzed using a Gumbel extreme value distribution fitted using the method of moments[(1)] as reported by Newark et al.[(2)] The resulting values are the snow depths, which have a probability of 1-in-50 of being exceeded in any one year.

The unit weight of old snow generally ranges from 2 to 5 kN/m^3, and it is usually assumed in Canada that 1 kN/m^3 is the average for new snow. Average unit weights of the seasonal snow pack have been derived for different regions across the country[(3)] and an appropriate value has been assigned to each weather station. Typically, the values average 2.01 kN/m^3 east of the continental divide (except for 2.94 kN/m^3 north of the treeline), and range from 2.55 to 4.21 kN/m^3 west of the divide. The product of the 1-in-50 snow depth and the average unit weight of the seasonal snow pack at a station is converted to the snow load (SL) in units of kilopascals (kPa).

Except for the mountainous areas of western Canada, the values of the ground snow load at AES stations were normalized assuming a linear variation of the load above sea level in order to account for the effects of topography. They were then smoothed using an uncertainty-weighted moving-area average in order to minimize the uncertainty due to snow depth sampling errors and site-specific variations. Interpolation from analyzed maps of the smooth normalized values yielded a value for each location in Table 1.2, which could then be converted to the listed code values (S_s) by means of an equation in the form:

$$S_s = \text{smooth normalized SL} + bZ$$

where b is the assumed rate of change of SL with elevation at the location and Z is the location's elevation above mean sea level (MSL). Although they are listed in Table 1.2 of Design Data to the nearest tenth of a kilopascal, values of S_s typically have an uncertainty of about 20%. Areas of sparse data in northern Canada were an exception to this procedure. In these regions, an analysis was made of the basic SL values. The effects of topography, variations due to local climates, and smoothing were all subjectively assessed. The values derived in this fashion were used to modify those derived objectively.

Tabulated values cannot be expected to indicate all the local differences in S_s. For this reason, especially in complex terrain areas, values should not be interpolated from Table 1.2 for unlisted locations. The values of S_s in Table 1.2 apply for the elevation and the latitude and longitude of the location, as defined by the Gazetteer of Canada. Values at other locations can be obtained from Environment Canada.

The heaviest loads frequently occur when the snow is wetted by rain, thus the rain load, S_r, was estimated to the nearest 0.1 kPa and is provided in Table 1.2. When values of S_r are added to S_s, this provides a 1-in-50-year estimate of the combined ground snow and rain load. The values of S_r are based on an analysis from weather station values of the 1-in-50-year one-day maximum rain amount. This return period is appropriate because the rain amounts correspond approximately to the joint frequency of occurrence of the one-day rain on maximum snow packs. For the purpose of estimating rain on snow, the individual observed one-day rain amounts were constrained to be less than or equal to the snow pack water equivalent, which was estimated by a snow pack accumulation model reported by Bruce and Clark.[4]

The results from surveys of snow loads on roofs indicate that average roof loads are generally less than loads on the ground. The conditions under which the design snow load on the roof may be taken as a percentage of the ground snow load are given in Subsection 4.1.6. of Division B of the Building Code. The Code also permits further decreases in design snow loads for steeply sloping roofs, but requires substantial increases for roofs where snow accumulation may be more rapid due to such factors as drifting. Recommended adjustments are given in the User's Guide - NBC 2010, Structural Commentaries (Part 4 of Division B).

Annual Total Precipitation

Total precipitation is the sum in millimetres of the measured depth of rainwater and the estimated or measured water equivalent of the snow (typically estimated as 0.1 of the measured depth of snow, since the average density of fresh snow is about 0.1 that of water).

The average annual total precipitation amounts in Table 1.2 have been interpolated from an analysis of precipitation observations from stations for the 30-year period from 1961 to 1990.

Annual Rainfall

The total amount of rain that normally falls in one year is frequently used as a general indication of the wetness of a climate, and is therefore included in this Supplementary Standard.

Rainfall Intensity

Roof drainage systems are designed to carry off rainwater from the most intense rainfall that is likely to occur. A certain amount of time is required for the rainwater to flow across and down the roof before it enters the gutter or drainage system. This results in the smoothing out of the most rapid changes in rainfall intensity. The drainage system, therefore, need only cope with the flow of rainwater produced by the average rainfall intensity over a period of a few minutes, which can be called the concentration time.

In Canada, it has been customary to use the 15-minute rainfall that will probably be exceeded on an average of once in 10 years. The concentration time for small roofs is much less than 15 minutes and hence the design intensity will be exceeded more frequently than once in 10 years. The safety factors in Part 7 of Division B of the Building Code will probably reduce the frequency to a reasonable value and, in addition, the occasional failure of a roof drainage system will not be particularly serious in most cases.

The rainfall intensity values were updated for the 2012 edition of the Building Code using observations of annual maximum 15-minute rainfall amounts from stations with 10 or more years of record, including data up to 2007 for some stations. Ten-year return period values - the 15-minute rainfall having a probability of 1-in-10 of being exceeded in any year- were calculated by fitting the annual maximum values to the Gumbel extreme value distribution[1] using the method of moments. The updated values are compiled from the most recent short-duration rainfall intensity-duration-frequency (IDF) graphs and tables available from Environment Canada.

It is very difficult to estimate the pattern of rainfall intensity in mountainous areas, where precipitation is extremely variable and rainfall intensity can be much greater than in other types of areas. Many of the observations for these areas were taken at locations in valley bottoms or in extensive, fairly level areas.

One-Day Rainfall

If for any reason a roof drainage system becomes ineffective, the accumulation of rainwater may be great enough in some cases to cause a significant increase in the load on the roof. In previous editions of this information, it had been common practice to use the maximum one-day rainfall ever observed for estimating the additional load. Since the length of record for weather stations in Canada is quite variable, the maximum one-day rainfall amounts in previous editions often reflected the variable length of record at nearby stations as much as the climatology. As a result, the maximum values often differed greatly within relatively small areas where little difference should be expected. The current values have been standardized to represent the one-day rainfall amounts that have 1 chance in 50 of being exceeded in any one year or the 1-in-50-year return value one-day rainfalls.

The one-day rainfall values were updated using daily rainfall observations from stations with 10 years or more of record, including data up to 2008 for some stations. The 50-year return period values were calculated by fitting the annual maximum one-day rainfall observations to the Gumbel extreme value distribution using the method of moments.[1]

Rainfall frequency observations can vary considerably over time and space. This is especially true for mountainous areas, where elevation effects can be significant. In other areas, small scale intense storms or local influences can produce significant spatial variability in the data. As a result, the analysis incorporates some spatial smoothing.

Driving Rain Wind Pressure (DRWP)

The presence of rainwater on the face of a building, with or without wind, must be addressed in the design and construction of the building envelope so as to minimize the entry of water into the assembly. Wind pressure on the windward faces of a building will promote the flow of water through any open joints or cracks in the facade.

Driving rain wind pressure (DRWP) is the wind load that is coincident with rain, measured or calculated at a height of 10 m. The values provided in Table 1.2 represent the loads for which there is 1 chance in 5 of being reached or exceeded in any one year, or a probability of 20% within any one year. Approximate adjustments for height can be made using the values for C_e given in Sentence 4.1.7.1.(5) of Division B as a multiplier.

Because of inaccuracies in developing the DRWP values related to the averaging of extreme wind pressures, the actual heights of recording anemometers, and the use of estimated rather than measured rainfall values, the values are considered to be higher than actual loads.[9] Thus the actual probability of reaching or exceeding the DRWP in a particular location is less than 20% per year and these values can be considered to be conservative.

DRWP can be used to determine the height to which wind will drive rainwater up enclosed vertical conduits. This provides a conservative estimate of the height needed for fins in window extrusions and end dams on flashings to control water ingress. This height can be calculated as:

$$\text{height of water, mm} = \text{DRWP} / 10, \text{Pa}$$

Note that the pressure difference across the building envelope may be augmented by internal pressures induced in the building interior by the wind. These additional pressures can be estimated using the information provided in the Commentary entitled Wind Load and Effects of the User's Guide - NBC 2010, Structural Commentaries (Part 4 of Division B).

Wind Effects

All structures need to be designed to ensure that the main structural system and all secondary components, such as cladding and appurtenances, will withstand the pressures and suctions caused by the strongest wind likely to blow at that location in many years. Some flexible structures, such as tall buildings, slender towers and bridges, also need to be designed to minimize excessive wind-induced oscillations or vibrations.

At any time, the wind acting upon a structure can be treated as a mean or time-averaged component and as a gust or unsteady component. For a small structure, which is completely enveloped by wind gusts, it is only the peak gust velocity that needs to be considered. For a large structure, the wind gusts are not well correlated over its different parts and the effects of individual

gusts become less significant. The User's Guide - NBC 2010, Structural Commentaries (Part 4 of Division B) evaluates the mean pressure acting on a structure, provide appropriate adjustments for building height and exposure and for the influence of the surrounding terrain and topography (including wind speed-up for hills), and then incorporate the effects of wind gusts by means of the gust factor, which varies according to the type of structure and the size of the area over which the pressure acts.

The wind speeds and corresponding velocity pressures used in the Code are regionally representative or reference values. The reference wind speeds are nominally one-hour averages of wind speeds representative of the 10 m height in flat open terrain corresponding to Exposure A or open terrain in the terminology of the User's Guide - NBC 2010, Structural Commentaries (Part 4 of Division B). The reference wind speeds and wind velocity pressures are based on long-term wind records observed at a large number of weather stations across Canada.

Reference wind velocity pressures in previous versions of the Code were based mostly on records of hourly averaged wind speeds (i.e, the number of miles of wind passing an anemometer in an hour) from stations across Canada with 10 to 22 years of observations ending in the 1950s. The wind pressure values derived from these measurements represented true hourly wind pressures.

The reference wind velocity pressures were reviewed and updated for the 2012 edition of the Building Code. The primary data set used for the analysis comprised wind records compiled from stations with hourly averaged wind speeds and from stations with aviation (one- or two-minute average) speeds or surface weather (ten-minute average) speeds observed once per hour at the top of the hour; the periods of record used ranged from 10 to 54 years. In addition, peak wind gust records from stations with periods of record ranging from 10 to 43 years were used. Peak wind gusts (gust durations of approximately 3 to 7 seconds) were used to supplement the primary once-per-hour observations in the analysis.

Several steps were involved in updating the reference wind values. Where needed, speeds were adjusted to represent the standard anemometer height above ground of 10 m. The data from years when the anemometer at a station was installed on the top of a lighthouse or building were eliminated from the analysis since it is impractical to adjust for the effects of wind flow over the structure. (Most anemometers were moved to 10 m towers by the 1960s.) Wind speeds of the various observation types-hourly averaged, aviation, surface weather and peak wind gust — were adjusted to account for different measure durations to represent a one-hour averaging period and to account for differences in the surface roughness of flat open terrain at observing stations.

The annual maximum wind speed data was fitted to the Gumbel distribution using the method of moments(1) to calculate hourly wind speeds having the annual probability of occurrence of 1-in-10 and 1-in-50 (10-year and 50-year return periods). The values were plotted on maps, then analyzed and abstracted for the locations in Table 1.2.

The wind velocity pressures, q, were calculated in Pascals using the following equation:

$$q = \frac{1}{2} \rho V^2$$

where ρ is an average air density for the windy months of the year and V is wind speed in metres per second. While air density depends on both air temperature and atmospheric pressure, the density of dry air at 0°C and standard atmospheric pressure of 1.2929 kg/m^3 was used as an average value for the wind pressure calculations. As explained by Boyd(6), this value is within 10% of the monthly average air densities for most of Canada in the windy part of the year.

As a result of the updating procedure, the 1-in-50 reference wind velocity pressures remain unchanged for most of the locations listed in Table 1.2; both increases and decreases were noted for the remaining locations. Many of the decreases resulted from the fact that anemometers at most of the stations used in the previous analysis were installed on lighthouses, airport hangers and other structures. Wind speeds on the tops of buildings are often much higher compared to those registered by a standard 10 m tower. Eliminating anemometer data recorded on the tops of buildings from the analysis resulted in lower values at several locations.

Hourly wind speeds that have 1 chance in 10 and 50[1] of being exceeded in any one year were analyzed using the Gumbel extreme value distribution fitted using the method of moments with correction for sample size. Values of the 1-in-30-year wind speeds for locations in Table 1.2 were estimated from a mapping analysis of wind speeds. The 1-in-10- and 1-in-50-year speeds were then computed from the 1-in-30-year speeds using a map of the dispersion parameter that occurs in the Gumbel analysis.[(1)]

Table 1.1 has been arranged to give pressures to the nearest one-hundredth of a kPa and their corresponding wind speeds. The value of "q" in kPa is assumed to be equal to 0.00064645 V^2, where V is given in m/s.

Seismic Hazard

The parameters used to represent seismic hazard for specific geographical locations are the 5%-damped horizontal spectral acceleration values for 0.2, 0.5, 1.0, and 2.0 second periods and the horizontal Peak Ground Acceleration (PGA) value that have a 2% probability of being exceeded in 50 years. The four spectral parameters are deemed sufficient to define spectra closely matching the shape of the Uniform Hazard Spectra (UHS). Hazard values are 50th percentile (median) values based on a statistical analysis of the earthquakes that have been experienced in Canada and adjacent regions.[(13)(14)(15)(16)] The median was chosen over the mean because the mean is affected by the amount of epistemic uncertainty incorporated into the analysis. It is the view of the Geological Survey of Canada and the members of the Standing Committee on Earthquake Design that the estimation of the epistemic uncertainty is still too incomplete to adopt into the Code.

The seismic hazard values were updated for the 2012 edition of the Building Code by replacing the quadratic fit that generated the 2006 Building Code values with a newly developed 8-parameter fit to the ground motion relations used for earthquakes in eastern, central and north-eastern Canada. In 2006, it was recognized that, while the quadratic fit provided a good approximation in the high-hazard zones, it was rather conservative at short periods, but not at long periods, for the low-hazard zones; however, as the design values are small in the low-hazard zones, the approximation was accepted. The 8-parameter fit gives a good fit across all zones. In general, PGA and short-period spectral values are reduced, while long-period values are increased. The 2012 values have the following engineering implications: geotechnical design levels (based on PGA values) are reduced, the design forces for short-period buildings are reduced, and the design forces for tall buildings are increased. Since zones of low seismicity cover a large part of the country, the seismic information for many of the localities listed in Table 1.2 has changed (often in a minor way).

Further details regarding the representation of seismic hazard can be found in the Commentary on Design for Seismic Effects in the User's Guide - NBC 2010, Structural Commentaries (Part 4 of Division B).

1 Wind speeds that have a one-in-"n"-year chance of being exceeded in any year can be computed from the one-in-10 and one-in-50 return values in Table 1.2 using the following equation:

$$V_{1/n} = \frac{1}{1.4565}\left\{V_{1/50} + 0.4565\, V_{1/10} + \frac{V_{1/50} - V_{1/10}}{1.1339} \times \ln \frac{-0.0339}{\ln(1-1/n)}\right\}$$

Table 1.1
Wind Speed

q kPa	V m/s	q kPa	V m/s	q kPa	V m/s	q kPa	V m/s
0.15	15.2	0.53	28.6	0.91	37.5	1.29	44.7
0.16	15.7	0.54	28.9	0.92	37.7	1.30	44.8
0.17	16.2	0.55	29.2	0.93	37.9	1.31	45.0
0.18	16.7	0.56	29.4	0.94	38.1	1.32	45.2
0.19	17.1	0.57	29.7	0.95	38.3	1.33	45.4
0.20	17.6	0.58	30.0	0.96	38.5	1.34	45.5
0.21	18.0	0.59	30.2	0.97	38.7	1.35	45.7
0.22	18.4	0.60	30.5	0.98	38.9	1.36	45.9
0.23	18.9	0.61	30.7	0.99	39.1	1.37	46.0
0.24	19.3	0.62	31.0	1.00	39.3	1.38	46.2
0.25	19.7	0.63	31.2	1.01	39.5	1.39	46.4
0.26	20.1	0.64	31.5	1.02	39.7	1.40	46.5
0.27	20.4	0.65	31.7	1.03	39.9	1.41	46.7
0.28	20.8	0.66	32.0	1.04	40.1	1.42	46.9
0.29	21.2	0.67	32.2	1.05	40.3	1.43	47.0
0.30	21.5	0.68	32.4	1.06	40.5	1.44	47.2
0.31	21.9	0.69	32.7	1.07	40.7	1.45	47.4
0.32	22.2	0.70	32.9	1.08	40.9	1.46	47.5
0.33	22.6	0.71	33.1	1.09	41.1	1.47	47.7
0.34	22.9	0.72	33.4	1.10	41.3	1.48	47.8
0.35	23.3	0.73	33.6	1.11	41.4	1.49	48.0
0.36	23.6	0.74	33.8	1.12	41.6	1.50	48.2
0.37	23.9	0.75	34.1	1.13	41.8	1.51	48.3
0.38	24.2	0.76	34.3	1.14	42	1.52	48.5
0.39	24.6	0.77	34.5	1.15	42.2	1.53	48.6
0.40	24.9	0.78	34.7	1.16	42.4	1.54	48.8
0.41	25.2	0.79	35.0	1.17	42.5	1.55	49.0
0.42	25.5	0.80	35.2	1.18	42.7	1.56	49.1
0.43	25.8	0.81	35.4	1.19	42.9	1.57	49.3
0.44	26.1	0.82	35.6	1.20	43.1	1.58	49.4
0.45	26.4	0.83	35.8	1.21	43.3	1.59	49.6
0.46	26.7	0.84	36.0	1.22	43.4	1.60	49.7
0.47	27.0	0.85	36.3	1.23	43.6	1.61	49.9
0.48	27.2	0.86	36.5	1.24	43.8	1.62	50.1
0.49	27.5	0.87	36.7	1.25	44.0	1.63	50.2
0.50	27.8	0.88	36.9	1.26	44.1	1.64	50.4
0.51	28.1	0.89	37.1	1.27	44.3	1.65	50.5
0.52	28.4	0.90	37.3	1.28	44.5	1.66	50.7
Column 1	2	3	4	5	6	7	8

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Table 1.2
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Ailsa Craig	230	-17	-19	30	23	3840	25	103	800	950	180	2.2	0.4	0.39	0.50	0.130	0.082	0.052	0.016	0.045
Ajax	95	-20	-22	30	23	3820	23	92	760	825	160	1.0	0.4	0.37	0.48	0.180	0.120	0.070	0.022	0.074
Alexandria	80	-24	-26	30	23	4600	25	103	800	975	160	2.4	0.4	0.31	0.40	0.640	0.310	0.140	0.047	0.320
Alliston	220	-23	-25	29	23	4200	28	113	690	875	120	2.0	0.4	0.28	0.36	0.150	0.099	0.062	0.020	0.046
Almonte	120	-26	-28	30	23	4620	25	97	730	800	140	2.5	0.4	0.32	0.41	0.550	0.270	0.130	0.042	0.280
Armstrong	340	-37	-40	28	21	6500	23	97	525	725	100	2.7	0.4	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Arnprior	85	-27	-29	30	23	4680	23	86	630	775	140	2.5	0.4	0.29	0.37	0.610	0.290	0.130	0.044	0.310
Atikokan	400	-33	-35	29	22	5750	25	103	570	760	100	2.4	0.3	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Attawapiskat	10	-37	-39	28	21	7100	18	81	450	650	160	2.8	0.3	0.32	0.41	0.110	0.057	0.026	0.008	0.053
Aurora	270	-21	-23	30	23	4210	28	108	700	800	140	2.0	0.4	0.34	0.44	0.160	0.110	0.065	0.021	0.053
Bancroft	365	-28	-31	29	23	4740	25	92	720	900	100	3.1	0.4	0.25	0.32	0.260	0.170	0.089	0.030	0.089
Barrie	245	-24	-26	29	23	4380	28	97	700	900	120	2.5	0.4	0.28	0.36	0.150	0.110	0.065	0.021	0.044
Barriefield	100	-22	-24	28	23	3390	23	108	780	950	160	2.1	0.4	0.36	0.47	0.300	0.180	0.099	0.031	0.120
Beaverton	240	-24	-26	30	23	4300	25	108	720	950	120	2.2	0.4	0.28	0.36	0.160	0.120	0.070	0.023	0.047
Belleville	90	-22	-24	29	23	3910	23	97	760	850	180	1.7	0.4	0.33	0.43	0.250	0.160	0.088	0.028	0.100
Belmont	260	-17	-19	30	24	3840	25	97	850	950	180	1.7	0.4	0.36	0.47	0.160	0.097	0.056	0.017	0.086
Big Trout Lake (Kitchenuhmaykoosib)	215	-38	-40	26	20	7450	18	92	400	600	150	3.2	0.2	0.33	0.42	0.095	0.057	0.026	0.008	0.036
CFB Borden	225	-23	-25	29	23	4300	28	103	690	875	120	2.2	0.4	0.28	0.36	0.140	0.100	0.063	0.020	0.045
Bracebridge	310	-26	-28	29	23	4800	25	103	830	1050	120	3.1	0.4	0.27	0.35	0.180	0.120	0.072	0.024	0.056
Bradford	240	-23	-25	30	23	4280	28	108	680	800	120	2.1	0.4	0.28	0.36	0.150	0.100	0.065	0.021	0.049
Brampton	215	-19	-21	30	23	4100	28	119	720	820	140	1.3	0.4	0.34	0.44	0.210	0.120	0.063	0.020	0.110
Brantford	205	-18	-20	30	23	3900	23	103	780	850	160	1.3	0.4	0.33	0.42	0.190	0.110	0.061	0.019	0.089
Brighton	95	-21	-23	29	23	4000	23	94	760	850	160	1.6	0.4	0.37	0.48	0.240	0.150	0.083	0.027	0.099
Brockville	85	-23	-25	29	23	4060	25	103	770	975	180	2.2	0.4	0.34	0.44	0.350	0.220	0.120	0.036	0.150
Burk's Falls	305	-26	-28	29	22	5020	25	97	810	1010	120	2.7	0.4	0.27	0.35	0.210	0.140	0.075	0.026	0.074
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Burlington	80	-17	-19	31	23	3740	23	103	770	850	160	0.9	0.4	0.36	0.46	0.320	0.170	0.064	0.022	0.180
Cambridge	295	-18	-20	29	23	4100	25	113	800	890	160	1.6	0.4	0.28	0.36	0.180	0.100	0.060	0.019	0.073
Campbellford	150	-23	-26	30	23	4280	25	97	730	850	160	1.7	0.4	0.32	0.41	0.230	0.150	0.085	0.027	0.084
Cannington	255	-24	-26	30	23	4310	25	108	740	950	120	2.2	0.4	0.28	0.36	0.170	0.120	0.070	0.023	0.048
Carleton Place	135	-25	-27	30	23	4600	25	97	730	850	160	2.5	0.4	0.32	0.41	0.490	0.250	0.120	0.039	0.230
Cavan	200	-23	-25	30	23	4400	25	97	740	850	140	2.0	0.4	0.34	0.44	0.190	0.130	0.076	0.024	0.061
Centralia	260	-17	-19	30	23	3800	25	103	820	1000	180	2.3	0.4	0.38	0.49	0.130	0.080	0.052	0.016	0.041
Chapleau	425	-35	-38	27	21	5900	20	97	530	850	80	4.0	0.4	0.23	0.30	0.095	0.057	0.037	0.013	0.036
Chatham	180	-16	-18	31	24	3470	28	103	800	850	180	1.0	0.4	0.33	0.43	0.160	0.092	0.050	0.015	0.088
Chesley	275	-19	-21	29	22	4320	28	103	810	1125	140	2.8	0.4	0.37	0.48	0.120	0.082	0.053	0.018	0.037
Clinton	280	-17	-19	29	23	4150	25	103	810	1000	160	2.6	0.4	0.38	0.49	0.120	0.078	0.050	0.016	0.038
Coboconk	270	-25	-27	30	23	4500	25	108	740	950	120	2.5	0.4	0.27	0.35	0.180	0.130	0.074	0.025	0.055
Cobourg	90	-21	-23	29	23	3980	23	94	760	825	160	1.2	0.4	0.38	0.49	0.220	0.140	0.079	0.025	0.096
Cochrane	245	-34	-36	29	21	6200	20	92	575	875	80	2.8	0.3	0.27	0.35	0.180	0.098	0.054	0.018	0.094
Colborne	105	-21	-23	29	23	3980	23	94	760	850	160	1.6	0.4	0.38	0.49	0.230	0.140	0.081	0.026	0.098
Collingwood	190	-21	-23	29	23	4180	28	97	720	950	160	2.7	0.4	0.30	0.39	0.130	0.097	0.060	0.020	0.040
Cornwall	35	-23	-25	30	23	4250	25	103	780	960	180	2.2	0.4	0.32	0.41	0.620	0.310	0.140	0.046	0.310
Corunna	185	-16	-18	31	24	3600	25	100	760	800	180	1.0	0.4	0.36	0.47	0.120	0.074	0.047	0.015	0.040
Deep River	145	-29	-32	30	22	4900	23	92	650	850	100	2.5	0.4	0.27	0.35	0.630	0.300	0.130	0.043	0.320
Deseronto	85	-22	-24	29	23	4070	23	92	760	900	160	1.9	0.4	0.33	0.43	0.270	0.170	0.092	0.029	0.110
Dorchester	260	-18	-20	30	24	3900	28	103	850	950	180	1.9	0.4	0.36	0.47	0.160	0.096	0.056	0.017	0.081
Dorion	200	-33	-35	28	21	5950	20	103	550	725	160	2.8	0.4	0.30	0.39	0.095	0.057	0.026	0.008	0.036
Dresden	185	-16	-18	31	24	3750	28	97	760	820	180	1.0	0.4	0.33	0.43	0.150	0.088	0.050	0.015	0.078
Dryden	370	-34	-36	28	22	5850	25	97	550	700	120	2.4	0.3	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Dundalk	525	-22	-24	29	22	4700	28	108	750	1080	150	3.4	0.4	0.33	0.42	0.130	0.091	0.058	0.019	0.043
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Dunnville	175	-15	-17	30	24	3660	23	108	830	950	160	2.0	0.4	0.36	0.46	0.310	0.160	0.063	0.021	0.170
Durham	340	-20	-22	29	22	4340	28	103	815	1025	140	2.8	0.4	0.34	0.44	0.120	0.085	0.055	0.018	0.040
Dutton	225	-16	-18	31	24	3700	28	92	850	925	180	1.3	0.4	0.36	0.47	0.160	0.096	0.054	0.017	0.087
Earlton	245	-33	-36	29	22	5730	23	92	560	820	120	2.6	0.4	0.35	0.45	0.240	0.140	0.075	0.024	0.110
Edison	365	-34	-36	28	22	5740	25	108	510	680	120	2.4	0.3	0.24	0.31	0.095	0.057	0.026	0.008	0.036
Elliot Lake	380	-26	-28	29	21	4950	23	108	630	950	160	2.9	0.4	0.29	0.38	0.095	0.065	0.043	0.015	0.036
Elmvale	220	-24	-26	29	23	4200	28	97	720	950	140	2.6	0.4	0.28	0.36	0.140	0.100	0.064	0.021	0.040
Embro	310	-19	-21	30	23	3950	28	113	830	950	160	2.0	0.4	0.37	0.48	0.150	0.094	0.056	0.018	0.072
Englehart	205	-33	-36	29	22	5800	23	92	600	880	100	2.5	0.4	0.32	0.41	0.230	0.130	0.074	0.024	0.110
Espanola	220	-25	-27	29	21	4920	23	108	650	840	160	2.3	0.4	0.33	0.42	0.100	0.080	0.050	0.018	0.036
Exeter	265	-17	-19	30	23	3900	25	113	810	975	180	2.4	0.4	0.38	0.49	0.130	0.080	0.051	0.016	0.040
Fenelon Falls	260	-25	-27	30	23	4440	25	108	730	950	120	2.3	0.4	0.28	0.36	0.180	0.130	0.074	0.024	0.054
Fergus	400	-20	-22	29	23	4300	28	108	760	925	160	2.2	0.4	0.28	0.36	0.160	0.095	0.058	0.019	0.052
Forest	215	-16	-18	31	23	3740	25	103	810	875	160	2.0	0.4	0.37	0.48	0.120	0.076	0.049	0.015	0.038
Fort Erie	180	-15	-17	30	24	3650	23	108	860	1020	160	2.6	0.4	0.36	0.46	0.330	0.180	0.067	0.022	0.200
Fort Erie (Ridgeway)	190	-15	-17	30	24	3600	25	108	860	1000	160	2.5	0.4	0.36	0.46	0.330	0.180	0.066	0.022	0.190
Fort Frances	340	-33	-35	29	22	5440	25	108	570	725	120	2.3	0.3	0.24	0.31	0.095	0.057	0.026	0.008	0.036
Gananoque	80	-22	-24	28	23	4010	23	103	760	900	180	2.1	0.4	0.36	0.47	0.300	0.190	0.100	0.032	0.120
Geraldton	345	-36	-39	28	21	6450	20	86	550	725	100	2.9	0.4	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Glencoe	215	-16	-18	31	24	3680	28	103	800	925	180	1.5	0.4	0.33	0.43	0.160	0.092	0.053	0.016	0.080
Goderich	185	-16	-18	29	23	4000	25	92	810	950	180	2.4	0.4	0.43	0.55	0.110	0.075	0.049	0.016	0.036
Gore Bay	205	-24	-26	28	22	4700	23	92	640	860	160	2.6	0.4	0.34	0.44	0.095	0.067	0.044	0.015	0.036
Graham	495	-35	-37	29	22	5940	23	97	570	750	140	2.6	0.3	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Gravenhurst (Muskoka Airport)	255	-26	-28	29	23	4760	25	103	790	1050	120	2.7	0.4	0.28	0.36	0.170	0.120	0.070	0.024	0.052
Grimsby	85	-16	-18	30	23	3520	23	108	760	875	160	0.9	0.4	0.36	0.46	0.340	0.180	0.068	0.022	0.200
Guelph	340	-19	-21	29	23	4270	28	103	770	875	140	1.9	0.4	0.28	0.36	0.170	0.100	0.059	0.019	0.067
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Guthrie	280	-24	-26	29	23	4300	28	103	700	950	120	2.5	0.4	0.28	0.36	0.150	0.110	0.066	0.022	0.043
Haileybury	210	-32	-35	30	22	5600	23	92	590	820	120	2.4	0.4	0.34	0.44	0.250	0.150	0.079	0.026	0.120
Haldimand (Caledonia)	190	-18	-20	30	23	3750	23	108	810	875	160	1.2	0.4	0.34	0.44	0.310	0.160	0.063	0.022	0.170
Haldimand (Hagersville)	215	-17	-19	30	23	3760	25	97	840	875	160	1.3	0.4	0.36	0.46	0.250	0.140	0.062	0.019	0.140
Haliburton	335	-27	-29	29	23	4840	25	92	780	980	100	2.9	0.4	0.27	0.35	0.220	0.150	0.081	0.027	0.074
Halton Hills (Georgetown)	255	-19	-21	30	23	4200	28	119	750	850	140	1.4	0.4	0.29	0.37	0.200	0.120	0.062	0.020	0.110
Hamilton																				
Above Escarpment - West of John C. Munro Int'l Airport	240	-17	-19	31	23	3460	23	108	810	875	160	1.5	0.4	0.36	0.46	0.320	0.170	0.064	0.022	0.180
Above Escarpment - East of John C. Munro Int'l Airport	200	-17	-19	31	23	3460	23	108	810	875	160	1.3	0.4	0.36	0.46	0.320	0.170	0.064	0.022	0.180
Below Escarpment - West of Highway 403	90	-17	-19	31	23	3460	23	108	810	875	160	1.1	0.4	0.36	0.46	0.320	0.170	0.064	0.022	0.180
Below Escarpment - East of Highway 403	90	-17	-19	31	23	3460	23	108	810	875	160	1.1	0.4	0.36	0.46	0.320	0.170	0.064	0.022	0.180
Hanover	270	-19	-21	29	22	4300	28	103	790	1050	140	2.6	0.4	0.37	0.48	0.120	0.082	0.053	0.018	0.039
Hastings	200	-24	-26	30	23	4280	25	92	730	840	140	2.0	0.4	0.32	0.41	0.220	0.140	0.083	0.027	0.074
Hawkesbury	50	-25	-27	30	23	4610	23	103	800	925	160	2.3	0.4	0.32	0.41	0.570	0.290	0.130	0.044	0.300
Hearst	245	-35	-37	29	21	6450	20	86	520	825	80	2.8	0.3	0.23	0.30	0.095	0.057	0.033	0.012	0.036
Honey Harbour	180	-24	-26	29	23	4300	25	97	710	1050	160	2.7	0.4	0.30	0.39	0.150	0.110	0.065	0.022	0.044
Hornepayne	360	-37	-40	28	21	6340	20	93	420	750	80	3.6	0.4	0.23	0.30	0.095	0.057	0.027	0.010	0.036
Huntsville	335	-26	-29	29	22	4850	25	103	800	1000	120	2.9	0.4	0.27	0.35	0.200	0.140	0.075	0.026	0.068
Ingersoll	280	-18	-20	30	23	3920	28	108	840	950	180	1.7	0.4	0.37	0.48	0.160	0.097	0.057	0.018	0.082
Iroquois Falls	275	-33	-36	29	21	6100	20	86	575	825	100	2.9	0.3	0.29	0.37	0.190	0.100	0.059	0.020	0.096
Jellicoe	330	-36	-39	28	21	6400	20	86	550	750	100	2.7	0.4	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Kapuskasing	245	-34	-36	29	21	6250	20	86	550	825	100	2.8	0.3	0.24	0.31	0.110	0.068	0.042	0.014	0.045
Kemptville	90	-25	-27	30	23	4540	25	92	750	925	160	2.3	0.4	0.32	0.41	0.560	0.280	0.130	0.042	0.280
Kenora	370	-33	-35	28	22	5630	25	113	515	630	120	2.3	0.3	0.24	0.31	0.095	0.057	0.026	0.008	0.036
Killaloe	185	-28	-31	30	22	4960	23	86	680	825	120	2.7	0.4	0.27	0.35	0.440	0.230	0.110	0.036	0.210
Kincardine	190	-17	-19	28	22	3890	25	92	800	950	180	2.6	0.4	0.43	0.55	0.110	0.075	0.049	0.016	0.036
Kingston	80	-22	-24	28	23	4000	23	108	780	950	180	2.1	0.4	0.36	0.47	0.290	0.180	0.099	0.031	0.120
Kinmount	295	-26	-28	29	23	4600	25	108	750	950	120	2.7	0.4	0.27	0.35	0.200	0.140	0.077	0.026	0.062
Kirkland Lake	325	-33	-36	29	22	6000	23	92	600	875	100	2.9	0.3	0.30	0.39	0.220	0.120	0.069	0.022	0.100
Kitchener	335	-19	-21	29	23	4200	28	119	780	925	140	2.0	0.4	0.29	0.37	0.160	0.095	0.058	0.018	0.054
Lakefield	240	-24	-26	30	23	4330	25	92	720	850	140	2.2	0.4	0.29	0.38	0.200	0.140	0.079	0.026	0.062
Lansdowne House	240	-38	-40	28	21	7150	23	92	500	680	140	2.9	0.2	0.25	0.32	0.095	0.057	0.026	0.008	0.036
Leamington	190	-15	-17	31	24	3400	28	113	800	875	180	0.8	0.4	0.36	0.47	0.170	0.092	0.047	0.015	0.091
Lindsay	265	-24	-26	30	23	4320	25	103	720	850	140	2.3	0.4	0.29	0.38	0.180	0.120	0.074	0.024	0.053
Lion's Head	185	-19	-21	27	22	4300	25	103	700	950	180	2.7	0.4	0.37	0.48	0.110	0.082	0.053	0.018	0.036
Listowel	380	-19	-21	29	23	4300	28	119	800	1000	160	2.6	0.4	0.36	0.47	0.130	0.085	0.054	0.018	0.043
London	245	-18	-20	30	24	3900	28	103	825	975	180	1.9	0.4	0.36	0.47	0.150	0.093	0.055	0.017	0.076
Lucan	300	-17	-19	30	23	3900	25	113	810	1000	180	2.3	0.4	0.39	0.50	0.130	0.083	0.052	0.017	0.046
Maitland	85	-23	-25	29	23	4080	25	103	770	975	180	2.2	0.4	0.34	0.44	0.370	0.220	0.120	0.036	0.150
Markdale	425	-20	-22	29	22	4500	28	103	820	1050	160	3.4	0.4	0.32	0.41	0.120	0.088	0.056	0.019	0.040
Markham	175	-21	-23	31	24	4000	25	86	720	825	140	1.3	0.4	0.34	0.44	0.180	0.110	0.067	0.022	0.061
Martin	485	-35	-37	29	22	5900	25	103	560	750	120	2.6	0.3	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Matheson	265	-33	-36	29	21	6080	20	86	580	825	100	2.8	0.3	0.30	0.39	0.200	0.110	0.063	0.020	0.098
Mattawa	165	-29	-31	30	22	5050	23	86	700	875	100	2.1	0.4	0.25	0.32	0.460	0.230	0.100	0.035	0.240
Midland	190	-24	-26	29	23	4200	25	97	740	1060	160	2.7	0.4	0.30	0.39	0.150	0.110	0.064	0.022	0.042
Milton	200	-18	-20	30	23	3920	25	125	750	850	160	1.3	0.4	0.33	0.43	0.260	0.140	0.063	0.020	0.140
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Milverton	370	-19	-21	29	23	4200	28	108	800	1050	160	2.4	0.4	0.33	0.43	0.140	0.086	0.054	0.018	0.044
Minden	270	-27	-29	29	23	4640	25	97	780	1010	100	2.7	0.4	0.27	0.35	0.200	0.140	0.078	0.026	0.065
Mississauga	160	-18	-20	30	23	3880	25	113	720	800	160	1.1	0.4	0.34	0.44	0.260	0.150	0.065	0.020	0.140
Mississauga (Lester B. Pearson International Airport)	170	-20	-22	31	24	3890	26	108	685	790	160	1.1	0.4	0.34	0.44	0.210	0.120	0.065	0.021	0.120
Mississauga (Port Credit)	75	-18	-20	29	23	3780	25	108	720	800	160	0.9	0.4	0.37	0.48	0.280	0.150	0.065	0.021	0.150
Mitchell	335	-18	-20	29	23	4100	28	113	810	1050	160	2.4	0.4	0.37	0.48	0.130	0.083	0.053	0.017	0.042
Moosonee	10	-36	-38	28	22	6800	18	81	500	700	160	2.2	0.3	0.27	0.35	0.130	0.068	0.040	0.014	0.057
Morrisburg	75	-23	-25	30	23	4370	25	103	800	950	180	2.3	0.4	0.32	0.41	0.600	0.300	0.140	0.044	0.310
Mount Forest	420	-21	-24	28	22	4700	28	103	740	940	140	2.7	0.4	0.32	0.41	0.130	0.087	0.055	0.018	0.043
Nakina	325	-36	-38	28	21	6500	20	86	540	750	100	2.8	0.4	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Nanticoke (Jarvis)	205	-17	-18	30	23	3700	28	108	840	900	160	1.4	0.4	0.37	0.48	0.220	0.120	0.062	0.019	0.120
Nanticoke (Port Dover)	180	-15	-17	30	24	3600	25	108	860	950	140	1.2	0.4	0.37	0.48	0.190	0.110	0.060	0.018	0.093
Napanee	90	-22	-24	29	23	4140	23	92	770	900	160	1.9	0.4	0.33	0.43	0.280	0.170	0.094	0.030	0.110
New Liskeard	180	-32	-35	30	22	5570	23	92	570	810	100	2.3	0.4	0.33	0.43	0.240	0.140	0.078	0.025	0.120
Newcastle	115	-20	-22	30	23	3990	23	86	760	830	160	1.5	0.4	0.37	0.48	0.200	0.130	0.074	0.024	0.081
Newcastle (Bowmanville)	95	-20	-22	30	23	4000	23	86	760	830	160	1.4	0.4	0.37	0.48	0.200	0.130	0.073	0.023	0.078
Newmarket	185	-22	-24	30	23	4260	28	108	700	800	140	2.0	0.4	0.29	0.38	0.160	0.110	0.065	0.021	0.051
Niagara Falls	210	-16	-18	30	23	3600	23	96	810	950	160	2.0	0.4	0.33	0.43	0.340	0.190	0.070	0.023	0.200
North Bay	210	-28	-30	28	22	5150	25	95	775	975	120	2.2	0.4	0.27	0.34	0.250	0.150	0.079	0.027	0.110
Norwood	225	-24	-26	30	23	4320	25	92	720	850	120	2.1	0.4	0.32	0.41	0.210	0.140	0.083	0.027	0.070
Oakville	90	-18	-20	30	23	3760	23	97	750	850	160	0.9	0.4	0.36	0.47	0.320	0.170	0.065	0.022	0.180
Orangeville	430	-21	-23	29	23	4450	28	108	730	875	140	2.3	0.4	0.28	0.36	0.150	0.097	0.060	0.020	0.051
Orillia	230	-25	-27	29	23	4260	25	103	740	1000	120	2.4	0.4	0.28	0.36	0.160	0.110	0.068	0.023	0.046
Oshawa	110	-19	-21	30	23	3860	23	86	760	875	160	1.4	0.4	0.37	0.48	0.190	0.120	0.072	0.023	0.074
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Ottawa (Metropolitan)																				
Ottawa (City Hall)	70	-25	-27	30	23	4440	23	86	750	900	160	2.4	0.4	0.32	0.41	0.640	0.310	0.140	0.046	0.320
Ottawa (Barrhaven)	98	-25	-27	30	23	4500	25	92	750	900	160	2.4	0.4	0.32	0.41	0.630	0.300	0.140	0.045	0.320
Ottawa (Kanata)	98	-25	-27	30	23	4520	25	92	730	900	160	2.5	0.4	0.32	0.41	0.620	0.300	0.130	0.045	0.320
Ottawa (MacDonald-Cartier Int'l Airport)	125	-25	-27	30	23	4500	24	89	750	900	160	2.4	0.4	0.32	0.41	0.630	0.310	0.140	0.046	0.320
Ottawa (Orleans)	70	-26	-28	30	23	4500	23	91	750	900	160	2.4	0.4	0.32	0.41	0.630	0.310	0.140	0.046	0.320
Owen Sound	215	-19	-21	29	22	4030	28	113	760	1075	160	2.8	0.4	0.37	0.48	0.120	0.085	0.055	0.018	0.036
Pagwa River	185	-35	-37	28	21	6500	20	86	540	825	80	2.4	0.4	0.23	0.30	0.095	0.057	0.026	0.009	0.036
Paris	245	-18	-20	30	23	4000	23	96	790	925	160	1.4	0.4	0.33	0.42	0.018	0.100	0.060	0.019	0.084
Parkhill	205	-16	-18	31	23	3800	25	103	800	925	180	2.1	0.4	0.39	0.50	0.120	0.079	0.051	0.016	0.041
Parry Sound	215	-24	-26	28	22	4640	23	97	820	1050	160	2.8	0.4	0.30	0.39	0.160	0.110	0.065	0.022	0.050
Pelham (Fonthill)	230	-15	-17	30	23	3690	23	96	820	950	160	2.3	0.4	0.33	0.42	0.340	0.190	0.068	0.022	0.200
Pembroke	125	-28	-31	30	23	4980	23	105	640	825	100	2.5	0.4	0.27	0.35	0.630	0.300	0.130	0.044	0.320
Penetanguishene	220	-24	-26	29	23	4200	25	97	720	1050	160	2.8	0.4	0.30	0.39	0.140	0.110	0.064	0.022	0.041
Perth	130	-25	-27	30	23	4540	25	92	730	900	140	2.3	0.4	0.32	0.41	0.360	0.210	0.110	0.036	0.140
Petawawa	135	-29	-31	30	23	4980	23	92	640	825	100	2.6	0.4	0.27	0.35	0.630	0.300	0.130	0.043	0.320
Peterborough	200	-23	-25	30	23	4400	25	92	710	840	140	2.0	0.4	0.32	0.41	0.190	0.130	0.078	0.025	0.062
Petrolia	195	-16	-18	31	24	3640	25	108	810	920	180	1.3	0.4	0.36	0.47	0.130	0.079	0.049	0.015	0.048
Pickering (Dumbarton)	85	-19	-21	30	23	3800	23	92	730	825	140	1.0	0.4	0.37	0.48	0.180	0.120	0.069	0.022	0.078
Picton	95	-21	-23	29	23	3980	23	92	770	940	160	2.0	0.4	0.38	0.49	0.260	0.160	0.088	0.028	0.110
Plattsville	300	-19	-21	29	23	4150	28	103	820	950	140	1.9	0.4	0.33	0.42	0.150	0.096	0.058	0.018	0.069
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Point Alexander	150	-29	-32	30	22	4960	23	92	650	850	100	2.5	0.4	0.27	0.35	0.630	0.300	0.130	0.043	0.320
Port Burwell	195	-15	-17	30	24	3800	25	92	930	1000	180	1.2	0.4	0.36	0.47	0.170	0.099	0.058	0.018	0.092
Port Colborne	180	-15	-17	30	24	3600	23	108	850	1000	160	2.3	0.4	0.36	0.46	0.330	0.180	0.066	0.022	0.190
Port Elgin	205	-17	-19	28	22	4100	25	92	790	850	180	2.8	0.4	0.43	0.55	0.110	0.078	0.051	0.017	0.036
Port Hope	100	-21	-23	29	23	3970	23	94	760	825	180	1.2	0.4	0.37	0.48	0.210	0.130	0.077	0.024	0.094
Port Perry	270	-22	-24	30	23	4260	25	97	720	850	140	2.4	0.4	0.34	0.44	0.170	0.120	0.070	0.023	0.053
Port Stanley	180	-15	-17	31	24	3850	25	92	940	975	180	1.2	0.4	0.36	0.47	0.170	0.099	0.055	0.017	0.090
Prescott	90	-23	-25	29	23	4120	25	103	770	975	180	2.2	0.4	0.34	0.44	0.420	0.240	0.120	0.038	0.018
Princeton	280	-18	-20	30	23	4000	25	97	810	925	160	1.5	0.4	0.33	0.42	0.160	0.100	0.059	0.018	0.082
Raith	475	-34	-37	28	22	5900	23	97	570	750	120	2.7	0.4	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Rayside-Balfour (Chelmsford)	270	-28	-30	29	21	5200	25	92	650	850	180	2.5	0.4	0.35	0.45	0.140	0.097	0.057	0.020	0.045
Red Lake	360	-35	-37	28	21	6220	20	92	470	630	120	2.4	0.3	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Renfrew	115	-27	-30	30	23	4900	23	97	620	810	140	2.5	0.4	0.27	0.35	0.580	0.290	0.130	0.043	0.300
Richmond Hill	230	-21	-23	31	24	4000	25	97	740	850	140	1.5	0.4	0.34	0.44	0.180	0.110	0.065	0.021	0.063
Rockland	50	-26	-28	30	23	4600	23	92	780	950	160	2.4	0.4	0.31	0.40	0.600	0.300	0.140	0.045	0.310
Sarnia	190	-16	-18	31	24	3750	25	100	750	825	180	1.1	0.4	0.36	0.47	0.120	0.073	0.048	0.015	0.037
Sault Ste. Marie	190	-25	-28	29	22	4960	23	97	660	950	200	3.1	0.4	0.34	0.44	0.095	0.057	0.032	0.012	0.036
Schreiber	310	-34	-36	27	21	5960	20	103	600	850	160	3.3	0.4	0.30	0.39	0.095	0.057	0.026	0.008	0.036
Seaforth	310	-17	-19	30	23	4100	25	108	810	1025	160	2.5	0.4	0.37	0.48	0.120	0.080	0.051	0.017	0.040
Shelburne	495	-22	-24	29	23	4700	28	108	740	900	150	3.1	0.4	0.31	0.40	0.140	0.094	0.059	0.020	0.046
Simcoe	210	-17	-19	30	24	3700	28	113	860	950	160	1.3	0.4	0.35	0.45	0.180	0.100	0.060	0.018	0.093
Sioux Lookout	375	-34	-36	28	22	5950	25	97	520	710	100	2.4	0.3	0.23	0.30	0.095	0.057	0.026	0.008	0.036
Smiths Falls	130	-25	-27	30	23	4540	25	92	730	850	140	2.3	0.4	0.32	0.41	0.390	0.220	0.120	0.037	0.170
Smithville	185	-16	-18	30	23	3650	23	108	800	900	160	1.5	0.4	0.33	0.42	0.340	0.180	0.068	0.022	0.200
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
		January		July 2.5%																
		2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r	1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
Smooth Rock Falls	235	-34	-36	29	21	6250	20	92	560	850	80	2.7	0.3	0.25	0.32	0.160	0.089	0.049	0.017	0.085
South River	355	-27	-29	29	22	5090	25	103	830	975	120	2.8	0.4	0.27	0.35	0.230	0.140	0.077	0.027	0.086
Southampton	180	-17	-19	28	22	4100	25	92	800	830	180	2.7	0.4	0.41	0.53	0.110	0.078	0.051	0.017	0.036
St. Catharines	105	-16	-18	30	23	3540	23	92	770	850	160	1.0	0.4	0.36	0.46	0.340	0.190	0.069	0.023	0.200
St. Mary's	310	-18	-20	30	23	4000	28	108	820	1025	160	2.2	0.4	0.36	0.47	0.140	0.086	0.054	0.017	0.049
St. Thomas	225	-16	-18	31	24	3780	25	103	900	975	180	1.4	0.4	0.36	0.47	0.160	0.096	0.056	0.017	0.088
Stirling	120	-23	-25	30	23	4220	25	97	740	850	120	1.7	0.4	0.31	0.40	0.250	0.160	0.088	0.028	0.096
Stratford	360	-18	-20	29	23	4050	28	113	820	1050	160	2.3	0.4	0.35	0.45	0.140	0.087	0.055	0.018	0.045
Strathroy	225	-17	-19	31	24	3780	25	103	770	950	180	1.9	0.4	0.36	0.47	0.140	0.086	0.052	0.016	0.064
Sturgeon Falls	205	-28	-30	29	21	5200	25	95	700	910	140	2.2	0.4	0.27	0.35	0.220	0.130	0.072	0.025	0.086
Sudbury	275	-28	-30	29	21	5180	25	97	650	875	200	2.5	0.4	0.36	0.46	0.150	0.100	0.059	0.020	0.051
Sundridge	340	-27	-29	29	22	5080	25	97	840	975	120	2.8	0.4	0.27	0.35	0.230	0.140	0.076	0.026	0.082
Tavistock	340	-19	-21	29	23	4100	28	113	820	1010	160	2.1	0.4	0.35	0.45	0.140	0.090	0.056	0.018	0.053
Temagami	300	-30	-33	30	22	5420	23	92	650	875	120	2.6	0.4	0.29	0.37	0.250	0.150	0.077	0.026	0.120
Thamesford	280	-19	-21	30	23	3950	28	108	820	975	160	1.9	0.4	0.37	0.48	0.160	0.095	0.056	0.018	0.076
Thedford	205	-16	-18	31	23	3710	25	103	810	900	180	2.1	0.4	0.39	0.50	0.120	0.077	0.050	0.016	0.038
Thunder Bay	210	-31	-33	29	21	5650	23	108	560	710	160	2.9	0.4	0.30	0.39	0.095	0.057	0.026	0.008	0.036
Tillsonburg	215	-17	-19	30	24	3840	25	103	880	980	160	1.3	0.4	0.34	0.44	0.170	0.100	0.058	0.018	0.091
Timmins	300	-34	-36	29	21	5940	20	108	560	875	100	3.1	0.3	0.27	0.35	0.140	0.090	0.054	0.018	0.056
Timmins (Porcupine)	295	-34	-36	29	21	6000	20	103	560	875	100	2.9	0.3	0.29	0.37	0.160	0.094	0.056	0.018	0.068
Toronto (Metropolitan)																				
Etobicoke	160	-20	-22	31	24	3800	26	108	720	800	160	1.1	0.4	0.34	0.44	0.210	0.120	0.065	0.021	0.110
North York	175	-20	-22	31	24	3760	25	108	730	850	150	1.2	0.4	0.34	0.44	0.190	0.110	0.066	0.021	0.078
Scarborough	180	-20	-22	31	24	3800	25	92	730	825	160	1.2	0.4	0.36	0.47	0.190	0.110	0.068	0.022	0.076
Toronto (City Hall)	90	-18	-20	31	23	3520	25	97	720	820	160	0.9	0.4	0.34	0.44	0.220	0.130	0.067	0.021	0.120
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 1.2 (Cont'd)
Design Data for Selected Locations in Ontario

Location	Elevation, m	Design Temperature January 2.5%, °C	Design Temperature January 1%, °C	Design Temperature July 2.5% Dry, °C	Design Temperature July 2.5% Wet, °C	Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50 S_s	Snow Load, kPa, 1/50 S_r	Hourly Wind Pressures, kPa 1/10	Hourly Wind Pressures, kPa 1/50	Seismic Data $S_a(0.2)$	Seismic Data $S_a(0.5)$	Seismic Data $S_a(1.0)$	Seismic Data $S_a(2.0)$	Seismic Data PGA
Trenton	80	-22	-24	29	23	4110	23	97	760	850	160	1.6	0.4	0.36	0.47	0.240	0.150	0.085	0.027	0.099
Trout Creek	330	-27	-29	29	22	5100	25	103	780	975	120	2.7	0.4	0.27	0.35	0.240	0.150	0.078	0.027	0.095
Uxbridge	275	-22	-24	30	23	4240	25	103	700	850	140	2.4	0.4	0.33	0.42	0.160	0.110	0.069	0.022	0.049
Vaughan (Woodbridge)	165	-20	-22	31	24	4100	26	113	700	800	140	1.1	0.4	0.34	0.44	0.190	0.110	0.064	0.021	0.081
Vittoria	215	-15	-17	30	24	3680	25	113	880	950	160	1.3	0.4	0.36	0.47	0.180	0.100	0.060	0.018	0.093
Walkerton	275	-18	-20	30	22	4300	28	103	790	1025	160	2.7	0.4	0.39	0.50	0.120	0.081	0.052	0.018	0.038
Wallaceburg	180	-16	-18	31	24	3600	28	97	760	825	180	0.9	0.4	0.35	0.45	0.150	0.085	0.047	0.015	0.071
Waterloo	330	-19	-21	29	23	4200	28	119	780	925	160	2.0	0.4	0.29	0.37	0.150	0.094	0.058	0.018	0.052
Watford	240	-17	-19	31	24	3740	25	108	790	950	160	1.9	0.4	0.36	0.47	0.130	0.081	0.050	0.016	0.050
Wawa	290	-34	-36	26	21	5840	20	93	725	950	160	4.1	0.4	0.30	0.39	0.095	0.057	0.028	0.010	0.036
Welland	180	-15	-17	30	23	3670	23	103	840	975	160	2.2	0.4	0.33	0.43	0.340	0.180	0.068	0.022	0.200
West Lorne	215	-16	-18	31	24	3700	28	103	840	900	180	1.3	0.4	0.36	0.47	0.160	0.095	0.054	0.016	0.088
Whitby	85	-20	-22	30	23	3820	23	86	760	850	160	1.2	0.4	0.37	0.48	0.190	0.120	0.071	0.022	0.075
Whitby (Brooklin)	160	-20	-22	30	23	4010	23	86	770	850	140	1.9	0.4	0.35	0.45	0.180	0.120	0.070	0.023	0.066
White River	375	-39	-42	28	21	6150	20	92	575	825	100	4.5	0.4	0.23	0.30	0.095	0.057	0.026	0.009	0.036
Wiarton	185	-19	-21	29	22	4300	25	103	740	1000	180	2.7	0.4	0.37	0.48	0.110	0.083	0.053	0.018	0.036
Windsor	185	-16	-18	32	24	3400	28	103	800	900	180	0.8	0.4	0.36	0.47	0.150	0.085	0.045	0.014	0.073
Wingham	310	-18	-20	30	23	4220	28	108	780	1050	160	2.6	0.4	0.39	0.50	0.120	0.079	0.051	0.017	0.039
Woodstock	300	-19	-21	30	23	3910	28	113	830	930	160	1.9	0.4	0.34	0.44	0.160	0.098	0.058	0.018	0.079
Wyoming	215	-16	-18	31	24	3700	25	103	815	900	180	1.6	0.4	0.36	0.47	0.130	0.077	0.049	0.015	0.043
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

SB-2 Fire-Performance Ratings

Section 1 General

This Supplementary Standard is based in large measure on Appendix D of the National Building Code of Canada 2010. The content of Appendix D was prepared on the recommendations of the Standing Committee on Fire Performance Ratings, which was established by the Canadian Commission on Building and Fire Codes (CCBFC) for this purpose.

1.1. Introduction

1.1.1. Scope

(1) This fire-performance information is presented in a form closely linked to the performance requirements and the minimum materials specifications of the 2012 Building Code.

(2) The ratings have been assigned only after careful consideration of all available literature on assemblies of common building materials, where they are adequately identified by description. The assigned values based on this information will, in most instances, be conservative when compared to the ratings determined on the basis of actual tests on individual assemblies.

(3) The fire-performance information set out in this Supplementary Standard applies to materials and assemblies of materials which comply in all essential details with the minimum structural design standards described in Part 4 of Division B in the 2012 Building Code. Additional requirements, where appropriate, are described in other Sections of this Supplementary Standard.

(4) Section 2 of this Supplementary Standard assigns fire-resistance ratings for walls, floors, roofs, columns and beams related to CAN/ULC-S101, "Fire Endurance Tests of Building Construction and Materials", and describes methods for determining these ratings.

(5) Section 3 assigns flame-spread ratings and smoke developed classifications for surface materials related to CAN/ULC-S102, "Test for Surface Burning Characteristics of Building Materials and Assemblies" and CAN/ULC-S102.2, "Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies".

(6) Section 4 describes noncombustibility in building materials when tested in accordance with CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials".

(7) Section 5 contains requirements for the installation of fire doors and fire dampers in fire-rated stud wall assemblies and the installation of fire stop flaps in fire-rated membrane ceilings.

(8) Section 6 contains background information regarding fire test reports, obsolete materials and assemblies, assessment of archaic assemblies and the development of the component additive method.

1.1.2. Referenced Documents

(1) Where documents are referenced in this Supplementary Standard, they shall be the editions designated in Table 1.1.2.

Table 1.1.2.
Documents Referenced in SB-2 Fire-Performance Ratings

Issuing Agency	Document Number	Title of Document	Reference
ANSI	A208.1-2009	Particleboard	Table 3.1.1.A.
ASTM	C330-05	Lightweight Aggregates for Structural Concrete	1.4.3.(2)
ASTM	C1396 / C1396M-06a	Gypsum Board	1.5.1.; Table 3.1.1.A.
CCBFC	NRCC 30629	Supplement to the National Building Code of Canada 1990	6.2.; 6.3.; 6.4.
CGSB	4-GP-36M-1978	Carpet Underlay, Fibre Type	Table 3.1.1.B.
CGSB	CAN/CGSB-4.129-97	Carpets for Commercial Use	Table 3.1.1.B.
CGSB	CAN/CGSB-11.3-M87	Hardboard	Table 3.1.1.A.
CGSB	CGSB-92.2-M90	Trowel or Spray Applied Acoustical Material	2.3.4.(5)
CSA	A23.1-09 / A23.2-09	Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete	1.4.3.(1)
CSA	A23.3-04	Design of Concrete Structures	2.1.5. (2); 2.6.6.(1) Table 2.6.6.B. 2.8.2.(1); Table 2.8.2.
CSA	A82.5-M1978	Structural Clay Non-Load-Bearing Tile	Table 2.6.1.A.
CSA	A82.22-M1977	Gypsum Plasters	Table 3.1.1.A.
CSA	CAN/CSA-A82.27-M91	Gypsum Board	1.5.1.; Table 3.1.1.A.
CSA	A82.30-M1980	Interior Furring, Lathing and Gypsum Plastering	1.7.2.(1); 2.3.9.(1) Table 2.5.1.
CSA	A82.31-M1980	Gypsum Board Application	2.3.9.(1); 2.3.9.(6)
CSA	CAN/CSA-A165.1-04	Concrete Block Masonry Units	Table 2.1.1.
CSA	O86-09	Engineering Design in Wood	2.11.2.(1); 2.11.2.(2)
CSA	O121-08	Douglas Fir Plywood	Table 3.1.1.A.
CSA	O141-05	Softwood Lumber	2.3.6.(2); Table 2.4.1.
CSA	O151-09	Canadian Softwood Plywood	Table 3.1.1.A.
CSA	O153-M1980	Poplar Plywood	Table 3.1.1.A.
CSA	CAN/CSA-O325-07	Construction Sheathing	Table 3.1.1.A.
CSA	O437.0-93	OSB and Waferboard	Table 3.1.1.A.
CSA	S16-09	Design of Steel Structures	2.6.6.(1); 2.6.6.(2) Table 2.6.6.B.
Column 1	2	3	4

Table 1.1.2. (Cont'd)
Documents Referenced in SB-2 Fire-Performance Ratings

Issuing Agency	Document Number	Title of Document	Code Reference
NFPA	80-2007	Fire Doors and Other Opening Protectives	5.2.1.(1); 5.2.1.(2)
ULC	CAN/ULC-S101-07	Fire Endurance Tests of Building Construction and Materials	1.1.1.(4); 1.12.1. 2.3.2.
ULC	CAN/ULC-S102-07	Test for Surface Burning Characteristics of Building Materials and Assemblies	1.1.1.(5)
ULC	CAN/ULC-S102.2-07	Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies	1.1.1.(5) Table 3.1.1.B.
ULC	CAN/ULC-S114–05	Test for Determination of Non-Combustibility in Building Materials	1.1.1.(6) 4.1.1.; 4.2.1.
ULC	ULC S505-1974	Fusible Links for Fire Protection Service	5.3.2.
ULC	CAN/ULC-S702-09	Mineral Fibre Thermal Insulation for Buildings	Table 2.3.4.A. Table 2.3.4.D. 2.3.5.(2); 2.3.5.(4) Table 2.6.1.E.; 6.4.
ULC	CAN/ULC-S703-01	Cellulose Fibre Insulation (CFI) for Buildings	2.3.4.(5)
ULC	CAN/ULC-S706-02	Wood Fibre Thermal Insulation for Buildings	Table 3.1.1.A.
Column 1	2	3	4

1.1.3. Applicability of Ratings

(1) The ratings shown in this document apply if more specific test values are not available. The construction of an assembly that is the subject of an individual test report must be followed in all essential details if the fire-resistance rating reported is to be applied for use with the Building Code.

1.1.4. Higher Ratings

(1) The authority having jurisdiction may allow higher fire-resistance ratings than those derived from this Supplementary Standard, where supporting evidence justifies a higher rating. Additional information is provided in summaries of published test information and the reports of fire tests carried out by the Institute for Research in Construction, National Research Council of Canada, included in Section 6, Background Information.

1.1.5. Additional Information on Fire Rated Assemblies

(1) Assemblies containing materials for which there is no nationally recognized standard are not included in this Supplementary Standard. Many such assemblies have been rated by Underwriters Laboratories (UL), Underwriters' Laboratories of Canada (ULC) or Intertek Testing Services NA Ltd. (ITS). The UL "Fire Resistance Directory", Volume 1, can be obtained from UL, 333 Pfingsten Road, Northbrook, Illinois 60062-2096 U.S.A. The ULC information is published in their "List of Equipment and Materials - Fire Resistance". Copies of this document may be obtained from ULC, 7 Underwriters Road, Toronto, Ontario M1R 3B4. ITS' Directory of Listed Products can be obtained from ITS, 3210 American Drive, Mississauga, Ontario L4V 1B3.

1.2. Interpretation of Test Results

1.2.1. Limitations

(1) The fire-performance ratings set out in this Supplementary Standard are based on those that would be obtained from the standard methods of test described in the Building Code. The test methods are essentially a means of comparing the performance of one building component or assembly with another in relation to its performance in fire.

(2) Since it is not practicable to measure the fire resistance of constructions in situ, they must be evaluated under some agreed test conditions. A specified fire-resistance rating is not necessarily the actual time that the assembly would endure in situ in a building fire, but is that which the particular construction must meet under the specified methods of test.

(3) Considerations arising from departures in use from the conditions established in the standard test methods may, in some circumstances, have to be taken into account by the designer and the authority having jurisdiction. Some of these conditions are covered at present by the provisions of the Building Code.

(4) For walls and partitions, the stud spacings previously specified as 16 and 24 inch on centre have been converted to 406 and 610 mm respectively to represent actual stud spacing used in the field to accommodate modular sheathing panel dimensions. These metric dimensions are deemed to comply with test results based on reported stud spacing of 400 mm or 600 mm on centre.

1.3. Concrete

1.3.1. Aggregates in Concrete

(1) Low density aggregate concretes generally exhibit better fire performance than natural stone aggregate concretes. A series of tests on concrete masonry walls, combined with mathematical analysis of the test results, has allowed further distinctions between certain low density aggregates to be made.

1.4. Types of Concrete

1.4.1. Description

(1) For purposes of this Supplementary Standard, concretes are described as Types S, N, L, L_1, L_2, L40S, $L_1$20S or $L_2$20S as described in Sentences (2) to (8).

(2) Type S concrete is the type in which the coarse aggregate is granite, quartzite, siliceous gravel or other dense materials containing at least 30% quartz, chert or flint.

(3) Type N concrete is the type in which the coarse aggregate is cinders, broken brick, blast furnace slag, limestone, calcareous gravel, trap rock, sandstone or similar dense material containing not more than 30% of quartz, chert or flint.

(4) Type L concrete is the type in which all the aggregate is expanded slag, expanded clay, expanded shale or pumice.

(5) Type L_1 concrete is the type in which all the aggregate is expanded shale.

(6) Type L_2 concrete is the type in which all the aggregate is expanded slag, expanded clay or pumice.

(7) Type L40S concrete is the type in which the fine portion of the aggregate is sand and low density aggregate in which the sand does not exceed 40% of the total volume of all aggregates in the concrete.

(8) Type $L_1$20S and Type $L_2$20S concretes are the types in which the fine portion of the aggregate is sand and low density aggregate in which the sand does not exceed 20% of the total volume of all aggregates in the concrete.

1.4.2. Determination of Ratings

(1) Where concretes are described as being of Type S, N, L, L_1 or L_2, the rating applies to the concrete containing the aggregate in the group that provides the least fire resistance. If the nature of an aggregate cannot be determined accurately enough to place it in one of the groups, the aggregate shall be considered as being in the group that requires a greater thickness of concrete for the required fire resistance.

1.4.3. Description of Aggregates

(1) The descriptions of the aggregates in Type S and Type N concretes apply to the coarse aggregates only. Coarse aggregate for this purpose means that retained on a 5 mm sieve using the method of grading aggregates described in CAN/CSA-A23.1 / A23.2, "Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete".

(2) Increasing the proportion of sand as fine aggregate in low density concretes requires increased thicknesses of material to produce equivalent fire-resistance ratings. Low density aggregates for Type L and Types L-S concretes used in loadbearing components shall conform to ASTM C330, "Lightweight Aggregates for Structural Concrete".

(3) Non-loadbearing low density components of vermiculite and perlite concrete, in the absence of other test evidence, shall be rated on the basis of the values shown for Type L concrete.

1.5. Gypsum Wallboard

1.5.1. Types of Wallboard

(1) Where the term gypsum wallboard is used in this Supplementary Standard, it is intended to include, in addition to gypsum wallboard, gypsum backing board and gypsum base for veneer plaster as described in
(a) CSA A82.27-M, "Gypsum Board", or
(b) ASTM C1396 / C1396M, "Gypsum Board".

(2) Where the term Type X gypsum wallboard is used in this Supplementary Standard, it applies to special fire-resistant board as described in
(a) CSA A82.27-M, "Gypsum Board",or
(b) ASTM C1396 / C1396M, "Gypsum Board".

1.6. Equivalent Thickness

1.6.1. Method of Calculating

(1) The thickness of solid-unit masonry and concrete described in this Supplementary Standard shall be the thickness of solid material in the unit or component thickness. For units that contain cores or voids, the Tables refer to the equivalent thickness determined in conformance with Sentences (2) to (10).

(2) Where a plaster finish is used, the equivalent thickness of a wall, floor, column or beam protection shall be equal to the sum of the equivalent thicknesses of the concrete or masonry units and the plaster finish measured at the point that will give the least value of equivalent thickness.

(3) Except as provided in Sentence (5), the equivalent thickness of a hollow masonry unit shall be calculated as equal to the actual overall thickness of a unit in millimetres multiplied by a factor equal to the net volume of the unit and divided by its gross volume.

(4) Net volume shall be determined using a volume displacement method that is not influenced by the porous nature of the units.

(5) Gross volume of a masonry unit shall be equal to the actual length of the unit multiplied by the actual height of the unit multiplied by the actual thickness of the unit.

(6) Where all the core spaces in a wall of hollow concrete masonry or hollow-core precast concrete units are filled with grout, mortar, or loose fill materials such as expanded slag, burned clay or shale (rotary kiln process), vermiculite or perlite, the equivalent thickness rating of the wall shall be considered to be the same as that of a wall of solid units, or a solid wall of the same concrete type and the same overall thickness.

(7) The equivalent thickness of hollow-core concrete slabs and panels having a uniform thickness and cores of constant cross section throughout their length shall be obtained by dividing the net cross-sectional area of the slab or panel by its width.

(8) The equivalent thickness of concrete panels with tapered cross sections shall be the cross section determined at a distance of 2 t or 150 mm, whichever is less, from the point of minimum thickness, where t is the minimum thickness.

(9) Except as permitted in Sentence (10), the equivalent thickness of concrete panels with ribbed or undulating surfaces shall be

(a) t_a for s less than or equal to 2 t,
(b) $t + (4\ t/s - 1)(t_a - t)$ for s less than 4 t and greater than 2 t, and
(c) t for s greater than or equal to 4 t

where

t = minimum thickness of panel,

t_a = average thickness of panel (unit cross-sectional area divided by unit width), and

s = centre to centre spacing of ribs or undulations.

(10) Where the total thickness of a panel described in Sentence (9), exceeds 2 t, only that portion of the panel which is less than 2 t from the non-ribbed surface shall be considered for the purpose of the calculations in Sentence (9).

1.7. Contribution of Plaster or Gypsum Wallboard Finish to Fire Resistance of Masonry or Concrete

1.7.1. Determination of Contribution

(1) Except as provided in Sentences (2) to (5), the contribution of a plaster or gypsum wallboard finish to the fire resistance of a masonry or concrete wall, floor or roof assembly shall be determined by multiplying the actual thickness of the finish by the factor shown in Table 1.7.1., depending on the type of masonry or concrete to which it is applied. This corrected thickness shall then be included in the equivalent thickness as described in Subsection 1.6.

(2) Where a plaster or gypsum wallboard finish is applied to a concrete or masonry wall, the calculated fire-resistance rating of the assembly shall not exceed twice the fire-resistance rating provided by the masonry or concrete because structural collapse may occur before the limiting temperature is reached on the surface of the non-fire-exposed side of the assembly.

(3) Where a plaster or gypsum wallboard finish is applied only on the non-fire-exposed side of a hollow clay tile wall, no increase in fire resistance is permitted because structural collapse may occur before the limiting temperature is reached on the surface of the non-fire-exposed side of the assembly.

(4) The contribution to fire resistance of a plaster or gypsum wallboard finish applied to the non-fire-exposed side of a monolithic concrete or unit masonry wall shall be determined in conformance with Sentence (1), but shall not exceed 0.5 times the contribution of the concrete or masonry wall.

(5) When applied to the fire-exposed side, the contribution of a gypsum lath and plaster or gypsum wallboard finish to the fire resistance of masonry or concrete wall, floor or roof assemblies shall be determined from Table 2.3.4.A. or 2.3.4.B.

Table 1.7.1.
Multiplying Factors for Masonry or Concrete Construction

Type of Surface Protection	Type of Masonry or Concrete			
	Solid Clay Brick, Unit Masonry and Monolithic Concrete, Type N or S	Cored Clay Brick, Clay Tile, Monolithic Concrete, Type L40S and Unit Masonry, Type $L_1$20S	Concrete Unit Masonry, Type L_1 or L_2 20S and Monolithic Concrete, Type L	Concrete Unit Masonry, Type L_2
Portland cement-sand plaster or lime sand plaster	1.00	0.75	0.75	0.50
Gypsum-sand plaster, wood fibred gypsum plaster or gypsum wallboard	1.25	1.00	1.00	1.00
Vermiculite or perlite aggregate plaster	1.75	1.50	1.25	1.25
Column 1	2	3	4	5

1.7.2. Plaster

(1) Gypsum plastering shall conform to CSA A82.30-M, "Interior Furring, Lathing and Gypsum Plastering".

(2) Portland cement-sand plaster shall be applied in 2 coats: the first coat containing 1 part Portland cement to 2 parts sand by volume, and the second coat containing 1 part Portland cement to 3 parts sand by volume.

(3) Plaster finish shall be securely bonded to the wall or ceiling.

(4) The thickness of plaster finish applied directly to monolithic concrete without metal lath shall not exceed 10 mm on ceilings and 16 mm on walls.

(5) Where the thickness of plaster finish on masonry or concrete exceeds 38 mm, wire mesh with 1.57 mm diam wire and openings not exceeding 50 mm by 50 mm shall be embedded midway in the plaster.

1.7.3. Attachment of Wallboard and Lath

(1) Gypsum wallboard and gypsum lath finishes applied to masonry or concrete walls shall be secured to wood or steel furring members in conformance with Article 2.3.9.

1.7.4. Sample Calculations

(1) The following examples are included as a guide to the method of calculating the fire resistance of concrete or hollow masonry walls with plaster or gypsum wallboard protection:

Example (1)

A 3 h fire-resistance rating is required for a monolithic concrete wall of Type S aggregate with a 20 mm gypsum-sand plaster finish on metal lath on each face.

(a) The minimum equivalent thickness of Type S monolithic concrete needed to give a 3 h fire-resistance rating = 158 mm (Table 2.1.1.).

(b) Since the gypsum-sand plaster finish is applied on metal lath, Sentence 1.7.1.(5) does not apply. Therefore, the contribution to the equivalent thickness of the wall of 20 mm gypsum-sand plaster on each face of the concrete is 20 x 1.25 = 25 mm (see Sentences 1.7.1.(1) to (4)).
(c) The total contribution of the plaster finishes is 2 x 25 = 50 mm.
(d) The minimum equivalent thickness of concrete required is 158 mm - 50 mm = 108 mm.
(e) From Table 2.1.1., the 108 mm equivalent thickness of monolithic concrete gives a contribution of less than 1.5 h. This is less than half the rating of the assembly so that the conditions in Sentence 1.7.1.(2) are not met. Thus the equivalent thickness of monolithic concrete must be increased to 112 mm to give 1.5 h contribution.
(f) The total equivalent thickness of the plaster finishes can then be reduced to 158 mm - 112 mm = 46 mm.
(g) The total actual thickness of the plaster finishes required is therefore 46 mm ÷ 1.25 = 37 mm (Sentences 1.7.1.(1) to (4)) or 18.5 mm on each face.
(h) Since the thickness of the plaster finish on each face exceeds 16 mm, metal lath is still required (Sentence 1.7.2.(4)).
(i) Since this wall is symmetrical with plaster on both faces, the contribution to fire resistance of the plaster finish on either face is limited to one-quarter of the wall rating by virtue of Sentence 1.7.1.(2). Under these circumstances, the conditions in Sentence 1.7.1.(4) are automatically met.

Example (2)

A 2 h fire-resistance rating is required for a hollow masonry wall of Type N concrete with a 12.7 mm Type X gypsum wallboard finish on each face.

(a) Since gypsum wallboard is used, Sentence 1.7.1.(5) applies. The 12.7 mm gypsum wallboard finish on the fire-exposed side is, therefore, assigned 25 min by using Table 2.3.4.A.
(b) The fire resistance required of the balance of the assembly is 120 min - 25 min = 95 min.
(c) Interpolating between 1.5 h and 2 h in Table 2.1.1. for 95 min fire resistance, the equivalent thickness for hollow masonry units required is 95 mm + (18 mm x 5/30) = 95 mm + 3 mm = 98 mm.
(d) The contribution to the equivalent thickness of the wall of the 12.7 mm gypsum wallboard finish on the non-fire-exposed side using Table 1.7.1. = 12.7 x 1.25 = 16 mm.
(e) Equivalent thickness required of concrete masonry unit = 98 - 16 = 82 mm.
(f) The fire-resistance rating of a concrete masonry wall having an equivalent thickness of 82 mm = 1 h for 73 mm + (9 mm x 30/22) = 1 h 12 min. As this is more than 1 h, the conditions of Sentence 1.7.1.(2) are met and the rating of 2 h is justified.

Example (3)

A 2 h fire-resistance rating is required for a hollow masonry exterior wall of Type $L_2$20S concrete with a 15.9 mm Type X gypsum wallboard finish on the non-fire-exposed side only.

(a) According to Table 2.1.1., the minimum equivalent thickness for Type $L_2$20S concrete masonry units needed to achieve a 2 h rating is 94 mm.
(b) Since gypsum wallboard is not used on the fire-exposed side, Sentence 1.7.1.(5) does not apply. The contribution to the equivalent thickness of the wall by the 15.9 mm Type X gypsum wallboard finish applied on the non-fire-exposed side is 15.9 x 1 ≈ 16 mm (see Sentence 1.7.1.(1) and Table 1.7.1.).
(c) Therefore, the equivalent thickness required of the concrete masonry unit is 94 - 16 = 78 mm.
(d) The contribution to fire resistance of a 78 mm $L_2$20S concrete hollow masonry unit is 85 min. The contribution of the Type X gypsum wallboard finish is 120 - 85 = 35 min, which does not exceed half the 85 min contribution of the masonry unit or 42.5 min, so that the conditions in Sentence 1.7.1.(4) are met.
(e) The rating of the wall (120 min) is less than twice the contribution of the masonry unit (170 min) so that the conditions in Sentence 1.7.1.(2) are also met.

1.8. Tests on Floors and Roofs

1.8.1. Exposure to Fire

(1) All tests relate to the performance of a floor assembly or floor-ceiling or roof-ceiling assembly above a fire. It has been assumed on the basis of experience that fire on top will take a longer time to penetrate the floor than one below, and that the fire resistance in such a situation will be at least equal to that obtained from below in the standard test.

1.9. Moisture Content

1.9.1. Effect of Moisture

(1) The moisture content of building materials at the time of fire test may have a significant influence on the measured fire resistance. In general, an increase in the moisture content should result in an increase in the fire resistance, though in some materials the presence of moisture may produce disruptive effects and early collapse of the assembly.

(2) Moisture content is now controlled in standard fire test methods and is generally recorded in the test reports. In earlier tests, moisture content was not always properly determined.

1.10. Permanence and Durability

1.10.1. Test Conditions

(1) The ratings in this Supplementary Standard relate to tested assemblies and do not take into account possible changes or deterioration in use of the materials. The standard fire test measures the fire resistance of a sample building assembly erected for the test. No judgment as to the permanence or durability of the assembly is made in the test.

1.11. Steel Structural Members

1.11.1. Thermal Protection

(1) Since the ability of a steel structural member to sustain the loading for which it was designed may be impaired because of elevated temperatures, measures shall be taken to provide thermal protection. The fire-resistance ratings, as established by the provisions of this Supplementary Standard, indicate the time periods during which the effects of heat on protected steel structural members are considered to be within acceptable limits.

1.12. Restraint Effects

1.12.1. Effect on Fire-Resistance Ratings

(1) In fire tests of floors, roofs and beams, it is necessary to state whether the rating applies to a thermally restrained or thermally unrestrained assembly. Edge restraint of a floor or roof, structural continuity, or end restraint of a beam can significantly extend the time before collapse in a standard test. A restrained condition is one in which expansion or rotation at the supports of a load-carrying element resulting from the effects of fire is resisted by forces or moments external to the element. An unrestrained condition is one in which the load-carrying element is free to thermally expand and rotate at its supports.

Whether an assembly or structural member can be considered thermally restrained or thermally unrestrained depends on the type of construction and location in a building. Guidance on this subject can be found in Appendix A1 of CAN/ULC-S101, "Fire Endurance Tests of Building Construction and Materials". Different acceptance criteria also apply to thermally unrestrained and thermally restrained assemblies. These are described in CAN/ULC-S101.

The ratings for floors, roofs, and beams in this Supplementary Standard meet the conditions of CAN/ULC-S101, "Fire Endurance Tests of Building Construction and Materials" for thermally unrestrained specimens. In a thermally restrained condition, the structural element or assembly would probably have greater fire resistance, but the extent of this increase can be determined only by reference to behavior in a standard test.

Section 2 Fire-Resistance Ratings

2.1. Masonry and Concrete Walls

2.1.1. Minimum Equivalent Thickness for Fire-Resistance Rating

(1) The minimum thicknesses of unit masonry and monolithic concrete walls are shown in Table 2.1.1. Hollow masonry units and hollow-core concrete panels shall be rated on the basis of equivalent thickness as described in Subsection 1.6.

Table 2.1.1.
Minimum Equivalent Thicknesses(1) of Unit Masonry and Monolithic Concrete Walls Loadbearing and Non-Loadbearing, mm

Type of Wall	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Solid brick units (80% solid and over), actual overall thickness	63	76	90	108	128	152	178
Cored brick units and hollow tile units (less than 80% solid), equivalent thickness	50	60	72	86	102	122	142
Solid and hollow concrete masonry units, equivalent thickness							
Type S or N concrete(2)	44	59	73	95	113	142	167
Type $L_1$20S concrete	42	54	66	87	102	129	152
Type L_1 concrete	42	54	64	82	97	122	143
Type $L_2$20S concrete	42	54	64	81	94	116	134
Type L_2 concrete	42	54	63	79	91	111	127
Monolithic concrete and concrete panels, equivalent thickness							
Type S concrete	60	77	90	112	130	158	180
Type N concrete	59	74	87	108	124	150	171
Type L40S or Type L concrete	49	62	72	89	103	124	140
Column 1	2	3	4	5	6	7	8

Notes to Table 2.1.1.:
(1) See definition of equivalent thickness in Subsection 1.6.
(2) Hollow concrete masonry units made with Type S or N concrete shall have a minimum compressive strength of 15 MPa based on net area, as defined in CAN/CSA-A165.1, "Concrete Block Masonry Units".

2.1.2. Applicability of Ratings

(1) Ratings obtained as described in Article 2.1.1. apply to either loadbearing or non-loadbearing walls, except for walls described in Sentences (2) to (6).

(2) Ratings for walls with a thickness less than the minimum thickness prescribed for loadbearing walls in this Supplementary Standard apply to non-loadbearing walls only.

(3) Masonry cavity walls (consisting of 2 wythes of masonry with an air space between) that are loaded to a maximum allowable compressive stress of 380 kPa have a fire resistance at least as great as that of a solid wall of a thickness equal to the sum of the equivalent thicknesses of the 2 wythes.

(4) Masonry cavity walls that are loaded to a compressive stress exceeding 380 kPa are not considered to be within the scope of this Supplementary Standard.

(5) A masonry wall consisting of 2 types of masonry units, either bonded together or in the form of a cavity wall, shall be considered to have a fire-resistance rating equal to that which would apply if the whole of the wall were of the material that gives the lesser rating.

(6) A non-loadbearing cavity wall made up of 2 precast concrete panels with an air space or insulation in the cavity between them shall be considered to have a fire-resistance rating as great as that of a solid wall of a thickness equal to the sum of the thicknesses of the 2 panels.

2.1.3. Framed Beams and Joists

(1) Beams and joists that are framed into a masonry or concrete fire separation shall not reduce the thickness of the fire separation to less than the equivalent thickness required for the fire separation.

2.1.4. Credit for Plaster Thickness

(1) On monolithic walls and walls of unit masonry, the full plaster finish on one or both faces multiplied by the factor shown in Table 1.7.1. shall be included in the wall thickness shown in Table 2.1.1., under the conditions and using the methods described in Subsection 1.7.

2.1.5. Walls Exposed to Fire on Both Sides

(1) Except as permitted in Sentence (2), portions of loadbearing reinforced concrete walls, which do not form a complete fire separation and thus may be exposed to fire on both sides simultaneously, shall have minimum dimensions and minimum cover to steel reinforcement in conformance with Articles 2.8.2. to 2.8.5.

(2) A concrete wall exposed to fire from both sides as described in Sentence (1) has a fire-resistance rating of 2 h if the following conditions are met:
(a) its equivalent thickness is not less than 200 mm,
(b) its aspect ratio (width/thickness) is not less than 4.0,
(c) the minimum thickness of concrete cover over the steel reinforcement specified in Clause (d) is not less than 50 mm,
(d) each face of the wall is reinforced with both vertical and horizontal steel reinforcement in conformance with either Clause 10 or Clause 14 of CAN/CSA-A23.3, "Design of Concrete Structures",
(e) the structural design of the wall is governed by the minimum eccentricity (15 + 0.03h) specified in Clause 10.15.3.1. of CAN/CSA-A23.3, "Design of Concrete Structures", and
(f) the effective length of the wall, kl_u, is not more than 3.7 m

where

k = effective length factor obtained from CAN/CSA-A23.3, "Design of Concrete Structures",

l_u = unsupported length of the wall in metres.

2.2. Reinforced and Prestressed Concrete Floor and Roof Slabs

2.2.1. Assignment of Rating

(1) Floors and roofs in a fire test are assigned a fire-resistance rating which relates to the time that an average temperature rise of 140°C or a maximum temperature rise of 180°C at any location is recorded on the unexposed side, or the time required for collapse to occur, whichever is the lesser. The thickness of concrete shown in Table 2.2.1.A. shall be required to resist the transfer of heat during the fire resistance period shown.

(2) The concrete cover over the reinforcement and steel tendons shown in Table 2.2.1.B. shall be required to maintain the integrity of the structure and prevent collapse during the same period.

Table 2.2.1.A.
Minimum Thickness of Reinforced and Prestressed Concrete Floor or Roof Slabs, mm

Type of Concrete	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S concrete	60	77	90	112	130	158	180
Type N concrete	59	74	87	108	124	150	171
Type L40S or Type L concrete	49	62	72	89	103	124	140
Column 1	2	3	4	5	6	7	8

Table 2.2.1.B.
Minimum Concrete Cover Over Reinforcement in Concrete Slabs, mm

Type of Concrete	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S, N, L40S or L concrete	20	20	20	20	25	32	39
Prestressed concrete slabs Type S, N, L40S or L Concrete	20	25	25	32	39	50	64
Column 1	2	3	4	5	6	7	8

2.2.2. Floors With Hollow Units

(1) The fire resistance of floors containing hollow units may be determined on the basis of equivalent thickness as described in Subsection 1.6.

2.2.3. Composite Slabs

(1) For composite concrete floor and roof slabs consisting of one layer of Type S or N concrete and another layer of Type L40S or L concrete in which the minimum thickness of both the top and bottom layers is not less than 25 mm, the combined fire-resistance rating may be determined using the following expressions:

(a) when the base layer consists of Type S or N concrete,

$$R = 0.00018t^2 - 0.00009td + \frac{8.7}{t}$$

(b) when the base layer consists of Type L40S or L concrete,

$$R = 0.0001t^2 + 0.0002td - 0.0001d^2 + \frac{6.4}{t}$$

where

R = fire resistance of slab, h,

t = total thickness of slab, mm, and

d = thickness of base layer, mm.

(2) If the base course described in Sentence (1) is covered by a top layer of material other than Type S, N, L40S or L concrete, the top course thickness may be converted to an equivalent concrete thickness by multiplying the actual thickness by the appropriate factor listed in Table 2.2.3.A. This equivalent concrete thickness may be added to the thickness of the base course and the fire-resistance rating calculated using Table 2.2.1.A.

(3) The minimum concrete cover under the main reinforcement for composite concrete floor and roof slabs with base slabs less than 100 mm thick shall conform to Table 2.2.3.B. For base slabs 100 mm or more thick, the minimum cover thickness requirements of Table 2.2.1.B. shall apply.

(4) Where the top layer of a 2-layer slab is less than 25 mm thick, the fire-resistance rating for the slab shall be calculated as though the entire slab were made up of the type of concrete with the lesser fire resistance.

Table 2.2.3.A.
Multiplying Factors for Equivalent Thickness

Top Course Material	Base Slab Normal Density Concrete (Type S or N)	Base Slab Low Density Concrete (Type L40S or L)
Gypsum wallboard	3.00	2.25
Cellular concrete (mass density 400 - 560 kg/m^3)	2.00	1.50
Vermiculite and perlite concrete (mass density 560 kg/m^3 or less)	1.75	1.50
Portland cement with sand aggregate	1.00	0.75
Terrazzo	1.00	0.75
Column 1	2	3

Table 2.2.3.B.
Minimum Concrete Cover Under Bottom Reinforcement in Composite Concrete Slabs, mm

Base Slab Concrete Type	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Reinforced concrete							
Type S, N, L40S or L	15	15	20	25	30	40	55
Prestressed concrete							
Type S	20	25	30	40	50	65	75
Type N	20	20	25	35	45	60	70
Type L40S or L	20	20	25	30	40	50	60
Column 1	2	3	4	5	6	7	8

2.2.4. Contribution of Plaster Finish

(1) The contribution of plaster finish securely fastened to the underside of concrete may be taken into account in floor or roof slabs under the conditions and using the methods described in Subsection 1.7.

(2) Plaster finish on the underside of concrete floors or roofs may be used in lieu of concrete cover referred to in Sentence 2.2.1.(2) under the conditions and using the methods described in Subsection 1.7.

2.2.5. Concrete Cover

(1) In prestressed concrete slab construction, the concrete cover over an individual tendon shall be the minimum thickness of concrete between the surface of the tendon and the fire-exposed surface of the slab, except that for ungrouted ducts the assumed cover thickness shall be the minimum thickness of concrete between the surface of the duct and the bottom of the slab. For slabs in which several tendons are used, the cover is assumed to be the average of those of individual tendons, except that the cover for any individual tendon shall be not less than half of the value given in Table 2.2.1.B. nor less than 20 mm.

(2) Except as provided in Sentence (3), in post-tensioned prestressed concrete slabs, the concrete cover to the tendon at the anchor shall be not less than 15 mm greater than the minimum cover required by Sentence (1). The minimum concrete cover to the anchorage bearing plate and to the end of the tendon, if it projects beyond the bearing plate, shall be 20 mm.

(3) The requirements of Sentence (2) do not apply to those portions of slabs not likely to be exposed to fire, such as the ends and tops.

2.2.6. Minimum Dimensions for Cover

(1) Minimum dimensions and cover to steel tendons of prestressed concrete beams shall conform to Subsection 2.10.

2.3. Wood and Steel Framed Walls, Floors and Roofs

2.3.1. Maximum Fire-Resistance Rating

(1) The fire-resistance rating of walls constructed of wood studs or light gauge steel studs, floors constructed of wood joists or open web steel joists, and roofs constructed of wood joists, pre-manufactured wood trusses or open web steel joists, can be determined for ratings up to 90 min from the information in Subsection 2.3.

2.3.2. Loadbearing Conditions

(1) The ratings derived from the information in Subsection 2.3. apply to both loadbearing and non-loadbearing wood framed walls, to non-loadbearing steel framed walls and to loadbearing floors and roofs.

(2) Loadbearing conditions shall be as defined in CAN/ULC-S101, "Fire Endurance Tests of Building Construction and Materials".

2.3.3. Limitations of Component Additive Method

(See Section 6 Background Information.)

(1) The fire-resistance rating of a framed assembly depends primarily on the time during which the membrane on the fire-exposed side remains in place.

(2) The assigned times in Sentences 2.3.4.(2) to (4) are not intended to be construed as the fire-resistance ratings of the individual components of an assembly. These assigned times are the individual contributions to the overall fire-resistance rating of the complete assembly.

(3) Wallboard membranes are permitted to be installed in multiple layers only as listed in Table 2.3.4.A. (Double 12.7 mm Type X gypsum wallboard).

2.3.4. Method of Calculation

(1) The fire-resistance rating of a framed assembly may be calculated by adding the time assigned in Sentence (2) for the membrane on the fire-exposed side plus the time assigned in Sentence (3) for the framing members plus the time assigned in Sentence (4) for additional protective measures such as the inclusion of insulation or the reinforcement of a membrane.

(2) The times which have been assigned to membranes on the fire-exposed side of the assembly, based on their ability to remain in place during fire tests, are listed in Tables 2.3.4.A. and 2.3.4.B. (This is not to be confused with the fire-resistance rating of the membrane, which also takes into account the rise in temperature on the unexposed side of the membrane. [See Sentence 2.3.3.(2).])

Table 2.3.4.A.
Time Assigned to Wallboard Membranes on Fire-Exposed Side

Description of Finish	Time, min
11.0 mm Douglas Fir plywood phenolic bonded	10(1)
14.0 mm Douglas Fir plywood phenolic bonded	15(1)
12.7 mm Type X gypsum wallboard	25
15.9 mm Type X gypsum wallboard	40
Double 12.7 mm Type X gypsum wallboard	80(2)
Column 1	2

Notes to Table 2.3.4.A.:

(1) Non-loadbearing walls only, stud cavities filled with mineral wool conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings", and having a mass of not less than 2 kg/m^2, with no additional credit for insulation according to Table 2.3.4.D.

(2) Applies to non-loadbearing steel framed walls only.

Table 2.3.4.B.
Time Assigned for Contribution of Lath and Plaster Protection on Fire-Exposed Side,(1) min

Type of Lath	Plaster Thickness, mm	Type of Plaster Finish		
		Portland Cement and Sand(2) or Lime and Sand, Time Assigned, min	Gypsum and Sand or Gypsum Wood Fibred, Time Assigned, min	Gypsum and Perlite or Gypsum and Vermiculite, Time Assigned, min
9.5 mm gypsum	13	—	35	55
	16	—	40	65
	19	—	50	80(1)
Metal	19	20	50	80(1)
	23	25	65	80(1)
	26	30	80	80(1)
Column 1	2	3	4	5

Notes to Table 2.3.4.B.:

(1) Values shown for these membranes have been limited to 80 min because the fire-resistance ratings of framed assemblies derived from these Tables shall not exceed 1.5 h.

(2) For mixture of Portland cement-sand plaster, see Sentence 1.7.2.(2).

(3) When the membrane on the fire-exposed side of a framed assembly falls off, there is a brief period before structural failure occurs during which the studs or joists are exposed directly to flame. Table 2.3.4.C. lists the times which have been assigned to the framing members based on the time involved between failure of the membrane and collapse of the assembly.

(4) Preformed insulation of glass, rock or slag fibre provides additional protection to wood studs by shielding the studs from exposure to the fire and thus delaying the time of collapse. The use of reinforcement in the membrane exposed to fire also adds to the fire resistance by extending the time to failure. Table 2.3.4.D. shows the time increments that may be added to the fire resistance if these features are incorporated in the assembly.

(5) Cellulose fibre insulation conforming to CAN/ULC-S703, "Cellulose Fibre Insulation (CFI) for Buildings", applied in conformance with CGSB-92.2-M, "Trowel or Spray Applied Acoustical Material", does not affect the fire-resistance rating of a steel stud wall assembly, provided that it is sprayed to either face of the wall cavity.

Table 2.3.4.C.
Time Assigned for Contribution of Wood or Light Steel Frame

Description of Frame	Time Assigned to Frame, min
Wood studs 406 mm o.c. maximum	20
Wood studs 610 mm o.c. maximum	15
Steel studs 406 mm o.c. maximum	10
Wood floor and wood roof joists 406 mm o.c. maximum	10
Open web steel joist floors and roofs with ceiling supports 406 mm o.c. maximum	10
Wood roof and wood floor truss assemblies 610 mm o.c. maximum	5
Column 1	2

Table 2.3.4.D.
Time Assigned for Additional Protection

Description of Additional Protection	Time Assigned, min
Add to the fire-resistance rating of wood stud walls, sheathed with gypsum wallboard or lath and plaster, if the spaces between the studs are filled with preformed insulation of rock or slag fibres conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings", and with a mass of not less than 1.22 kg/m² of wall surface(1)	15
Add to the fire-resistance rating of non-loadbearing wood stud walls, sheathed with gypsum wallboard or lath and plaster, if the spaces between the studs are filled with preformed insulation of glass fibres conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings", and having a mass of not less than 0.6 kg/m² of wall surface	5
Add to the fire-resistance rating of plaster on gypsum lath ceilings if 0.76 mm diam wire mesh with 25 mm by 25 mm openings or 1.57 mm diam diagonal wire reinforcing at 250 mm o.c. is placed between lath and plaster	30
Add to the fire-resistance rating of plaster on gypsum lath ceilings if 76 mm wide metal lath strips are placed over joints between lath and plaster	10
Add to the fire-resistance rating of plaster on 9.5 mm thick gypsum lath ceilings (Table 2.3.4.B.) if supports for lath are 305 mm o.c.	10
Column 1	2

Notes to Table 2.3.4.D.:

(1) There are no test data to justify the 15 min additional protection for preformed glass fibre.

2.3.5. Considerations for Various Types of Assemblies

(1) Interior vertical fire separations shall be rated for exposure to fire on each side, and a membrane shall be provided on both sides of the assembly. In the calculation of the fire-resistance rating of such an assembly, however, no contribution to

fire-resistance can be assigned for a membrane on the non-fire-exposed side, since this membrane may fail when the structural members fail.

(2) When an exterior wall assembly is required to be rated from the interior side only, such wall assemblies shall have an outer membrane consisting of sheathing and exterior cladding with spaces between the studs filled with insulation conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings", and having a mass of not less than 1.22 kg/m^2 of wall surface.

(3) In the case of a floor or roof, the standard test provides only for testing for fire exposure from below. Floor or roof assemblies of wood, light-gauge steel members or open-web steel joist framing shall have an upper membrane consisting of a subfloor and finish floor conforming to Table 2.3.5. or any other membrane that has a contribution to fire resistance of not less than 15 min in Table 2.3.4.A. For the purposes of this requirement, it is not necessary to comply with note (1) to Table 2.3.4.A.

(4) Insulation used in the cavities of a wood floor assembly will not reduce the assigned fire-resistance rating of the assembly provided:
(a) the insulation is preformed of rock, slag or glass fibre conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings", and having a mass of not more than 1.1 kg/m^2 and is installed adjacent to the bottom edge of the framing member, directly above steel furring channels,
(b) the gypsum wallboard ceiling membrane is attached to
  (i) wood trusses in conformance with Sentence 2.3.9.(2) by way of steel drywall furring channels spaced not more than 406 mm o.c., and the channels are secured to each bottom truss member with a double strand of 1.2 mm galvanized steel wire, or
  (ii) wood joists by way of drywall or resilient steel furring channels spaced not more than 406 mm o.c. in conformance with Sentences 2.3.9.(2) and (3), and
(c) a steel furring channel is installed midway between each furring channel mentioned in Clause (b) to provide additional support for the insulation.

Table 2.3.5.
Flooring of Roofing Membranes for Wood, Cold Formed Steel Members or Open-Web Steel Joists

Type of Assembly	Structural Members	Subfloor or Roof Deck	Finish Flooring or Roofing
Floor	Wood or steel joists and wood trusses	12.5 mm plywood or 17 mm T & G softwood	Hardwood or softwood flooring on building paper Resilient flooring, parquet floor, felted synthetic fibre floor coverings, carpeting, or ceramic tile on 8 mm thick panel-type underlay Ceramic tile on 30 mm mortar bed
	Steel joists	50 mm reinforced concrete or 50 mm concrete on metal lath or formed steel sheet, or 40 mm reinforced gypsum-fibre concrete on 12.7 mm gypsum wallboard	Finish flooring
Roof	Wood or steel joists and wood trusses	12.5 mm plywood or 17 mm T & G softwood	Finish roofing material with or without insulation
	Steel joists	50 mm reinforced concrete or 50 mm concrete on metal lath or formed steel sheet, or 40 mm reinforced gypsum-fibre concrete on 12.7 mm gypsum wallboard	Finish roofing material with or without insulation
Column 1	2	3	4

2.3.6. Framing Members

(1) The values shown in Tables 2.3.4.A., 2.3.4.B. and 2.3.12. apply to membranes supported on framing members installed in their conventional orientation and spaced in conformance with Table 2.3.4.C.

(2) Wood studs and wood roof and floor framing members are assumed to be not less than 38 mm by 89 mm. Wood trusses are assumed to consist of wood chord and web framing members and connector plates fabricated from not less than 1 mm thick galvanized steel with projecting teeth not less than 8 mm long. Dimensions for dressed lumber are given in CSA O141, "Softwood Lumber".

(3) The allowable spans for wood joists listed in Part 9 of Division B are provided for floors supporting specific occupancies.

(4) Except as otherwise required in this Supplementary Standard, metal studs shall be of galvanized steel not less than 0.5 mm thick, not less than 63 mm wide and with a flange width of not less than 31 mm.

(5) Metal studs in walls required to have a fire-resistance rating shall be installed with not less than 12 mm clearance between the top of the stud and the top of the runner to allow for expansion in the event of fire. Where attachment of the studs is necessary for alignment purposes during erection, such attachment shall be made to the bottom runners only.

(6) Except as required in Sentence 2.3.5.(4), resilient or drywall furring channels may be used to attach a gypsum wallboard ceiling membrane to a floor or roof assembly. The channels must be of galvanized steel not less than 0.5 mm thick, placed at a spacing of not more than 610 mm o.c. perpendicular to the framing members, with an overlap of not less than 100 mm at splices and a minimum end clearance between the channels and walls of 15 mm.

2.3.7. Plaster Finish

(1) The thickness of plaster finish shall be measured from the face of gypsum or metal lath.

2.3.8. Edge Support for Wallboard

(1) Gypsum wallboard installed over framing or furring shall be installed so that all edges are supported, except that 15.9 mm Type X gypsum wallboard may be installed horizontally with the horizontal joints unsupported when framing members are at 406 mm o.c. maximum.

2.3.9. Membrane Fastening

(1) Except as provided in Sentences (2) to (6), the application of lath and plaster finish shall conform to CSA A82.30-M, "Interior Furring, Lathing and Gypsum Plastering", and gypsum wallboard finish shall conform to CSA A82.31-M, "Gypsum Board Application".

(2) Where a membrane referred to in Tables 2.3.4.A., 2.3.4.B. and 2.3.12. is applied to steel framing or furring, fasteners shall penetrate not less than 10 mm through the metal.

(3) Except as provided in Sentences (4) and (5) where a membrane referred to in Tables 2.3.4.A., 2.3.4.B. and 2.3.12. is applied to wood framing or furring, minimum fastener penetrations into wood members shall conform to Table 2.3.9. for the time assigned to the membrane.

(4) Where a membrane is applied in 2 layers, the fastener penetrations described in Table 2.3.9. shall apply to the base layer. Fasteners for the face layer shall penetrate not less than 20 mm into wood supports.

Table 2.3.9.
Minimum Fastener Penetrations for Membrane Protection on Wood Frame, mm

Type of Membrane	Assigned Contribution of Membrane to Fire Resistance[1] min					
	5 – 25	30 – 35	40	50	55 – 70	80
Single layer	20	29	32	—	—	—
Double layer	20	20	20	29	35	44
Gypsum lath	20	20	23	23	29	29
Column 1	2	3	4	5	6	7

Notes to Table 2.3.9.:

(1) Assigned contributions of membranes to fire resistance are determined in Tables 2.3.4.A., 2.3.4.B. and 2.3.12.

(5) Where adhesives are used to attach the face layer of gypsum wallboard in a double layer application for walls, the top and bottom of the face layer shall be secured to the supports by mechanical fasteners having lengths as required in Sentences (2) and (4) and spaced not more than 150 mm o.c. for wood supports and not more than 200 mm o.c. for steel supports.

(6) In a double layer application of gypsum wallboard on wood supports, fastener spacing shall conform to CSA A82.31-M, "Gypsum Board Application".

2.3.10. Ceiling Membrane Openings - Combustible Construction

(1) Except as permitted in Article 2.3.12., where a floor or roof assembly of combustible construction is assigned a fire-resistance rating on the basis of Subsection 2.3. and incorporates a ceiling membrane described in Table 2.3.4.A. or 2.3.4.B., the ceiling membrane may be penetrated by openings leading to ducts within concealed spaces above the membrane provided:
(a) the assembly is not required to have a fire-resistance rating in excess of 1 h,
(b) the area of any openings does not exceed 930 cm^2 (see Sentence (2)),
(c) the aggregate area of openings does not exceed 1% of the ceiling area of the fire compartment,
(d) the depth of the concealed space above the ceiling is not less than 230 mm,
(e) no dimension of any opening exceeds 310 mm,
(f) supports are provided for openings with any dimension exceeding 150 mm where framing members are spaced greater than 406 mm o.c.,
(g) individual openings are spaced not less than 2 m apart,
(h) the ducts above the membrane are sheet steel and are supported by steel strapping firmly attached to the framing members, and
(i) the clearance between the top surface of the membrane and the bottom surface of the ducts is not less than 100 mm.

(2) Where an individual opening permitted in Sentence (1) exceeds 130 cm^2 in area, it shall be protected by
(a) a fire stop flap conforming to Subsection 5.3., or
(b) thermal protection above the duct consisting of the same materials as used for the ceiling membrane, mechanically fastened to the ductwork and extending 200 mm beyond the opening on all sides (see Figure 2.3.10.).

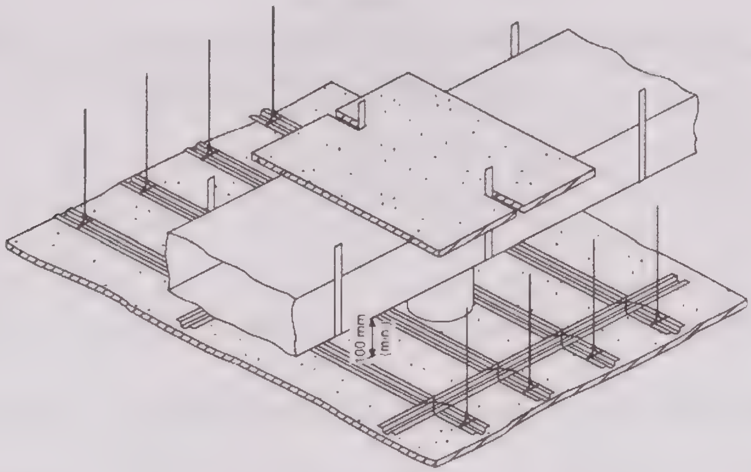


Figure 2.3.10.
Thermal Protection Above a Duct

2.3.11. Ceiling Membrane Openings - Noncombustible Construction

(1) Except as permitted in Article 2.3.12., where a floor or roof assembly of noncombustible construction is assigned a fire-resistance rating on the basis of Subsection 2.3. and incorporates a ceiling membrane described in Table 2.3.4.A. or 2.3.4.B., the ceiling membrane may be penetrated by openings leading to ducts located within concealed spaces provided:
(a) the area of any opening does not exceed 930 cm^2 (see Sentence (2)),
(b) the aggregate area of openings does not exceed 2% of the ceiling area of the fire compartment,
(c) no dimension of any opening exceeds 400 mm,
(d) individual openings are spaced not less than 2 m apart,
(e) openings are located not less than 200 mm from major structural members such as beams, columns or joists,
(f) the ducts above the membrane are sheet steel and are supported by steel strapping firmly attached to the framing members, and
(g) the clearance between the top surface of the membrane and the bottom surface of the duct is not less than 100 mm.

(2) Where an individual opening permitted in Sentence (1) exceeds 130 cm^2 in area, it shall be protected by
(a) a fire stop flap conforming to Subsection 5.3., or
(b) thermal protection above the duct consisting of the same materials as used for the ceiling membrane, mechanically fastened to the ductwork and extending 200 mm beyond the opening on all sides (see Figure 2.3.10.).

2.3.12. Ceiling Membrane Rating

(1) Where the fire-resistance rating of a ceiling assembly is to be determined on the basis of the membrane only and not of the complete assembly, the ratings may be determined from Table 2.3.12., provided no openings are located within the ceiling membrane.

Table 2.3.12.
Fire-Resistance Rating for Ceiling Membranes

Description of Membrane	Fire-Resistance Rating, min
15.9 mm Type X gypsum wallboard with ≥ 75 mm mineral wool batt insulation above wallboard	30
19 mm gypsum-sand plaster on metal lath	30
Double 14.0 mm Douglas Fir plywood phenolic bonded	30
Double 12.7 mm Type X gypsum wallboard	45
25 mm gypsum-sand plaster on metal lath	45
Double 15.9 mm Type X gypsum wallboard	60
32 mm gypsum-sand plaster on metal lath	60
Column 1	2

2.3.13. Beams

(1) Where a beam is included with an open-web steel joist or similar construction and is protected by the same continuous ceiling, the beam is assumed to have a fire-resistance rating equal to that assigned to the rest of the assembly.

(2) The ratings in this Supplementary Standard assume that the construction to which the beam is related is a normal one and does not carry unusual loads from the floor or slab above.

2.3.14. Wired Glass Assemblies

(1) Openings in a vertical fire separation having a fire-resistance rating of not more than 1 h are allowed to be protected by wired glass assemblies, provided the wired glass is
(a) not less than 6 mm thick;
(b) reinforced by a steel wire mesh in the form of diamonds, squares or hexagons having dimensions of
  (i) approximately 25 mm across the flats, using wire of not less than 0.45 mm diam, or
  (ii) approximately 13 mm across the flats, using wire of not less than 0.40 mm diam, the wire to be centrally embedded during manufacture and welded or intertwined at each intersection;
(c) set in fixed steel frames with metal not less than 1.35 mm thick and providing a glazing stop of not less than 20 mm on each side of the glass; and
(d) limited in area so that
  (i) individual panes are not more than 0.84 m^2, with neither height nor width more than 1.4 m, and
  (ii) the area not structurally supported by mullions is not more than 7.5 m^2.

(2) It is intended that the structural mullions referred to in Subclause(1)(d)(ii) will not distort or be displaced to the extent that there would be a failure of the wired glass closure during the period for which a closure in the fire separation would be expected to function. Hollow structural steel tubing not less than 100 mm square filled with a Portland cement-based grout will satisfy the intent of the Subclause.

2.4. Solid Wood Walls, Floors and Roofs

2.4.1. Minimum Thickness

(1) The minimum thickness of solid wood walls, floors and roofs for fire-resistance ratings from 30 min to 1.5 h is shown in Table 2.4.1.

Table 2.4.1.
Minimum Thickness of Solid Wood Walls, Roofs and Floors,[1][2] mm

Type of Construction	Fire-Resistance Rating			
	30 min	45 min	1 h	1.5 h
Solid wood floor with building paper and finish flooring on top[3]	89	114	165	235
Solid wood, splined or tongued and grooved floor with building paper and finish flooring on top[4]	64	76	—	—
Solid wood walls of loadbearing vertical plank[3]	89	114	140	184
Solid wood walls of non-loadbearing horizontal plank[3]	89	89	89	140
Column 1	2	3	4	5

Notes to Table 2.4.1.:
(1) See CSA O141, "Softwood Lumber", for sizes.
(2) The fire-resistance ratings and minimum dimensions for floors also apply to solid wood roof decks of comparable thickness with finish roofing material.
(3) The assembly shall consist of 38 mm thick members on edge fastened together with 101 mm common wire nails spaced not more than 400 mm o.c. and staggered in the direction of the grain.
(4) The floor shall consist of 64 mm by 184 mm wide planks either tongued and grooved or with 19 mm by 38 mm splines set in grooves and fastened together with 88 mm common nails spaced not more than 406 mm o.c.

2.4.2. Increased Fire-Resistance Rating

(1) The fire-resistance rating of the assemblies described in Table 2.4.1. may be increased by 15 min if one of the following finishes is applied on the fire-exposed side:
(a) 12.7 mm thick gypsum wallboard,
(b) 20 mm thick gypsum-sand plaster on metal lath, or
(c) 13 mm thick gypsum-sand plaster on 9.5 mm gypsum lath.

(2) Fastening of the plaster to the wood structure shall conform to Subsection 2.3.

2.4.3. Supplementary Ratings

(1) Supplementary ratings based on tests are included in Table 2.4.3. The ratings given shall apply to constructions that conform in all details with the descriptions given.

Table 2.4.3.
Fire-Resistance Rating of Non-Loadbearing Built-up Solid Wood Partitions(1)

Construction Details	Actual Overall Thickness, mm	Fire-Resistance Rating
Solid panels of wood boards 64 mm to 140 mm wide grooved and joined with wood splines, nailed together, boards placed vertically with staggered joints, 3 boards thick	58	30 min
Solid panels with 4 mm plywood facings(2) glued to 46 mm solid wood core of glued, tongued and grooved construction for both sides and ends of core pieces with tongued and grooved rails in the core about 760 mm apart	54	1 h
Column 1	2	3

Notes to Table 2.4.3.:
(1) The ratings and notes are taken from "Fire Resistance Classifications of Building Constructions", Building Materials and Structures Report BMS 92, National Bureau of Standards, Washington, 1942.
(2) Ratings for plywood faced panel are based on phenolic resin glue being used for gluing facings to wood frames. If other types of glue are used for this purpose, the ratings apply if the facings are nailed to the frames in addition to being glued.

2.5. Solid Plaster Partitions

2.5.1. Minimum Thickness

(1) The minimum thickness of solid plaster partitions for fire-resistance ratings from 30 min to 4 h is shown in Table 2.5.1.

Table 2.5.1.
Minimum Thickness of Non-Loadbearing Solid Plaster Partitions, mm

Type of Plaster on Metal Lath(1)	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Portland cement-sand(2) or Portland cement-lime-sand	50(3)	—	—	—	—	—	—
Gypsum-sand	50(3)	50(3)	64	—	—	—	—
Gypsum-vermiculite, gypsum-perlite, Portland cement-vermiculite or Portland cement-perlite	50(3)	50(3)	50(3)	58	64	83	102
Column 1	2	3	4	5	6	7	8

Notes to Table 2.5.1.:
(1) Metal lath shall be expanded metal lath or welded woven wire fabric supported on 19 mm vertical light steel studs spaced not more than 610 mm o.c. Plaster shall be applied to both sides of the lath.
(2) For mixture of Portland cement-sand plaster, see Sentence 1.7.2.(2).
(3) CSA A82.30-M, "Interior Furring, Lathing and Gypsum Plastering", does not permit solid plaster partitions less than 50 mm thick.

2.6. Protected Steel Columns

2.6.1. Minimum Thickness of Protective Covering

(1) The minimum thickness of protective covering to steel columns is shown in Tables 2.6.1.A. to 2.6.1.F. for fire-resistance ratings from 30 min to 4 h.

Table 2.6.1.A.
Minimum Thickness of Concrete or Masonry Protection to Steel Columns, mm

Description of Cover	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Monolithic concrete							
Type S concrete(1) (column spaces filled)(2)	25	25	25	25	39	64	89
Type N or L concrete(1) (column spaces filled)(2)	25	25	25	25	32	50	77
Concrete masonry units(3) or precast reinforced concrete units							
Type S concrete (column spaces not filled)	50	50	50	50	64	89	115
Type N or L concrete (column spaces not filled)	50	50	50	50	50	77	102
Clay or shale brick(4) (column spaces filled)	50	50	50	50	50	64	77
Clay or shale brick(4) (column spaces not filled)	50	50	50	50	50	77	102
Hollow clay tile(5) (column spaces filled)(2)	50(6)	50(6)	50(6)	50(6)	(7)	(7)	(7)
Hollow clay tile(5) (column spaces not filled)(2)	50(6)	50(6)	50(6)	—	—	—	—
Column 1	2	3	4	5	6	7	8

Notes to Table 2.6.1.A.:

(1) Applies to cast-in-place concrete reinforced with 5.21 mm diam wire wrapped around column spirally 200 mm o.c., or 1.57 mm diam wire mesh with 100 mm by 100 mm openings.

(2) The space between the protective covering and the web or flange of the column shall be filled with concrete, cement mortar or a mixture of cement mortar and broken bricks.

(3) Concrete masonry shall be reinforced with 5.21 mm diam wire or wire mesh with 1.19 mm diam wire and 10 mm by 10 mm openings, laid in every second course.

(4) Brick cover 77 mm thick or less shall be reinforced with 2.34 mm diam wire or 1.19 mm diam wire mesh with 10 mm by 10 mm openings, laid in every second course.

(5) Hollow clay tiles and masonry mortar shall be reinforced with 1.19 mm diam wire mesh with 10 mm by 10 mm openings, laid in every horizontal joint and lapped at corners.

(6) Hollow clay tiles shall conform to CSA A82.5-M, "Structural Clay Non-Load-Bearing Tile".

(7) 50 mm nominal hollow clay tile, reinforced with 1.19 mm diam wire mesh with 10 mm by 10 mm openings laid in every horizontal joint and covered with 19 mm gypsum-sand plaster and with limestone concrete fill in column spaces, has a 4 h fire-resistance rating.

Table 2.6.1.B.
Minimum Thickness of Plaster Protection to Steel Columns, mm

Description	Fire-Resistance Rating[1][2]						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Gypsum-sand plaster on 9.5 mm gypsum lath[3]	13	13	13	20	—	—	—
Gypsum-perlite or vermiculite plaster on 9.5 mm gypsum lath[3]	13	13	13	20	25	—	—
Gypsum perlite or vermiculite plaster on 12.7 mm gypsum lath[3]	13	13	13	20	25	32	50
Gypsum perlite or vermiculite plaster on double 12.7 mm gypsum lath[3]	13	13	13	20	25	25	32
Portland cement-sand plaster on metal lath[4][5]	25	25	25	—	—	—	—
Column 1	2	3	4	5	6	7	8

Notes to Table 2.6.1.B.:

(1) Fire-resistance ratings of 30 min and 45 min apply to columns whose M/D ratio is 30 or greater. Fire-resistance ratings greater than 45 min apply to columns whose M/D ratio is greater than 60. Where the M/D ratio is between 30 and 60 and the required fire-resistance rating is greater than 45 min, the total thickness of protection specified in the Table shall be increased by 50%. (To determine M/D, refer to Article 2.6.4.)

(2) Where the thickness of plaster over gypsum lath is 25 mm or more, wire mesh with 1.57 mm diam wire and openings not exceeding 50 mm by 50 mm shall be placed midway in the plaster.

(3) Lath held in place by 1.19 mm diam wire wrapped around lath 450 mm o.c.

(4) Expanded metal lath 1.36 kg/m^2 fastened to 9.5 mm by 19 mm steel channels held in vertical position around column by 1.19 mm diam wire ties.

(5) For mixture of Portland cement-sand plaster, see Sentence 1.7.2.(2).

Table 2.6.1.C.
Minimum Thickness of Gypsum-Sand Plaster on Metal Lath Protection to Steel Columns, mm

M/D[1]	Fire-Resistance Rating					
	30 min	45 min	1 h	1.5 h	2 h	3 h
30 to 60	16	16	32	—	—	—
over 60 to 90	16	16	16	32	—	—
over 90 to 120	16	16	16	25	39	—
over 120 to 180	16	16	16	16	25	—
over 180	16	16	16	16	25	39
Column 1	2	3	4	5	6	7

Notes to Table 2.6.1.C.:

(1) To determine the M/D ratio, refer to Article 2.6.4.

Table 2.6.1.D.
Minimum Thickness of Gypsum-Perlite or Gypsum-Vermiculite Plaster on Metal Lath Protection to Steel Columns, mm

M/D(1)	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
30 to 60	16	16	20	32	35	—	—
over 60 to 90	16	16	16	20	26	35	45
over 90 to 120	16	16	16	16	26	35	45
over 120 to 180	16	16	16	16	20	32	35
over 180	16	16	16	16	16	26	35
Column 1	2	3	4	5	6	7	8

Notes to Table 2.6.1.D.:

(1) To determine the M/D ratio, refer to Article 2.6.4.

Table 2.6.1.E.
Steel Columns with Sheet-Steel Membrane and Insulation as Shown in Figures 2.6.1.A. and 2.6.1.B.

Type of Protection	Steel Thickness,(1) mm	Fastening(2)	Insulation	Fire-Resistance Rating
See Figure 2.6.1.A.	0.51	No. 8 sheet-metal screws 9.5 mm long, 200 mm o.c.	50 mm mineral wool batts(3)	45 min
See Figure 2.6.1.B.	0.64	Self-threading screws or No. 8 sheet-metal screws, 600 mm o.c.	2 layers 12.7 mm gypsum wallboard	1.5 h
See Figure 2.6.1.A.	0.64	No. 8 sheet-metal screws, 9.5 mm long, 200 mm o.c.	75 mm mineral wool batts,(3) 12.7 mm gypsum wallboard	2 h
See Figure 2.6.1.B.	0.76	Crimped joint or No. 8 sheet-metal screws, 300 mm o.c.	2 layers 15.9 mm gypsum wallboard	2 h
Column 1	2	3	4	5

Notes to Table 2.6.1.E.:

(1) Minimum thickness, galvanized or wiped-zinc-coated sheet-steel.

(2) Sheet-steel shall be securely fastened to the floor and superstructure, or where sheet-steel cover does not extend floor to floor, fire stopping shall be provided at the level where sheet-steel protection ends. In the latter case, an alternate type of fire protection shall be applied between the fire stopping and the superstructure.

(3) Conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings", Type 1A, minimum density 30 kg/m^3: column section and batts wrapped with 25 mm mesh chicken wire.

Table 2.6.1.F.
Minimum M/D Ratio for Steel Columns Covered With Type X Gypsum Wallboard Protection[1]

Minimum Thickness of Type X Gypsum Wallboard Protection[2], mm	Fire-Resistance Rating			
	1 h	1.5 h	2 h	3 h
12.7	75	—	—	—
15.9	55	—	—	—
25.4	35	60	—	—
28.6	35	50	—	—
31.8	35	40	75	—
38.1	35	35	55	—
41.3	35	35	45	—
44.5	35	35	35	—
47.6	35	35	35	—
50.8	35	35	35	75
63.5	35	35	35	45
Column 1	2	3	4	5

Notes to Table 2.6.1.F.:

(1) To determine the M/D ratio, refer to Article 2.6.4.

(2) See Article 2.6.5.

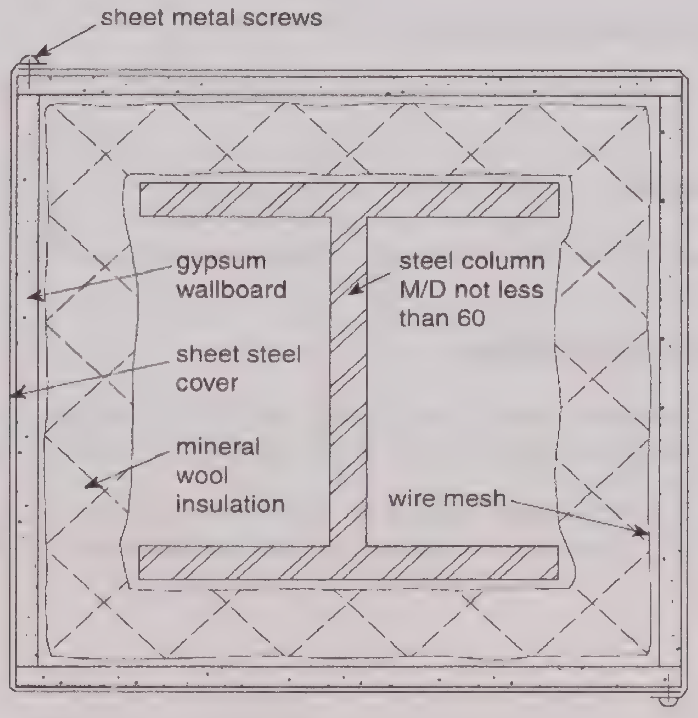


Figure 2.6.1.A.
Column Protected by Sheet-Steel Membrane and Mineral-Wool Insulation

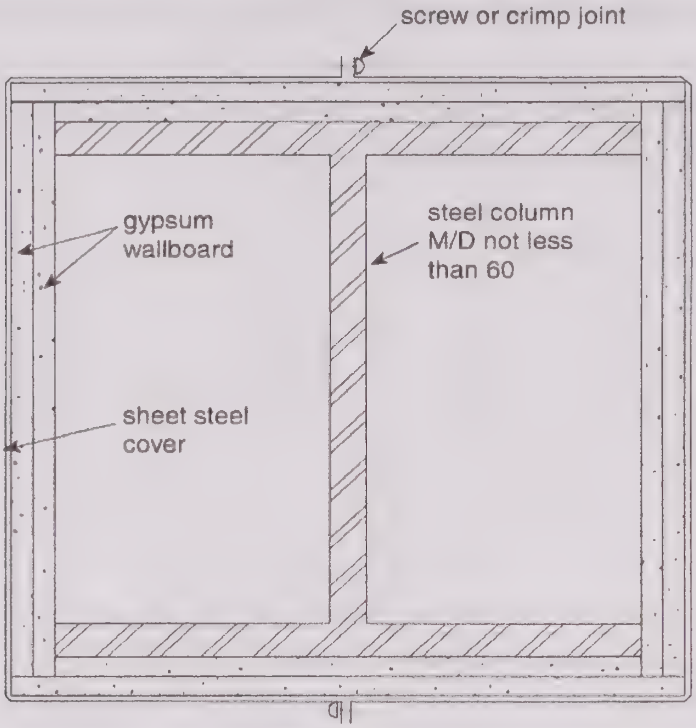


Figure 2.6.1.B.
Column Protected by Sheet-Steel Membrane and Gypsum Wallboard

2.6.2. Hollow Unit Masonry Columns

(1) For hollow-unit masonry column protection, the thickness shown in Tables 2.6.1.A. to 2.6.1.D. is the equivalent thickness as described in Subsection 1.6.

2.6.3. Effect of Plaster

(1) The effect on fire-resistance ratings of the addition of plaster to masonry and monolithic concrete column protection is described in Subsection 1.7.

2.6.4. Determination of M/D Ratio

(1) The ratio M/D to which reference is made in Tables 2.6.1.B., 2.6.1.C., 2.6.1.D. and 2.6.1.F. shall be found by dividing "M," the mass of the column in kilograms per metre by "D," the heated perimeter of the steel column section in metres.

(2) The heated perimeter "D" of steel columns, shown as the dashed line in Figure 2.6.4.A., shall be equal to 2 (B+H) in Examples (1) and (2), and 3.14B in Example (3). In Figure 2.6.4.B., the heated perimeter "D" shall be equal to 2 (B+H).

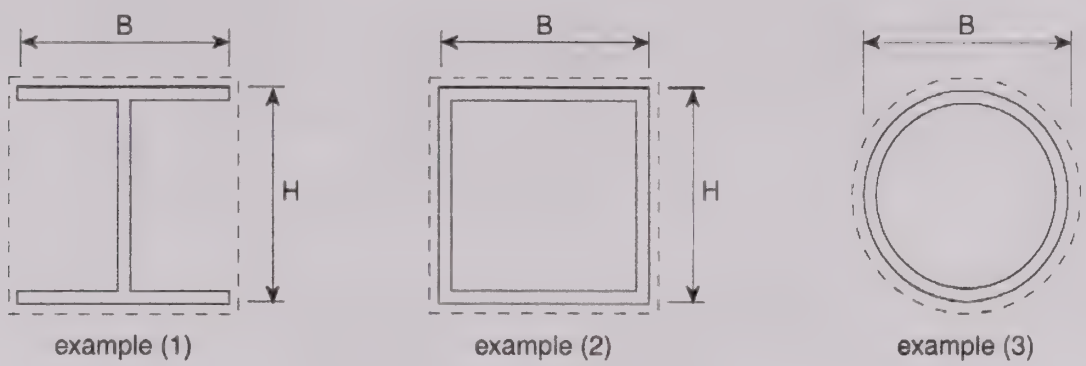


Figure 2.6.4.A.
Example (1), Standard or Wide-Flange Beam,
Example (2), Hollow Structural Section (Rectangular or Square),
Example (3), Hollow Structural Section (Round)

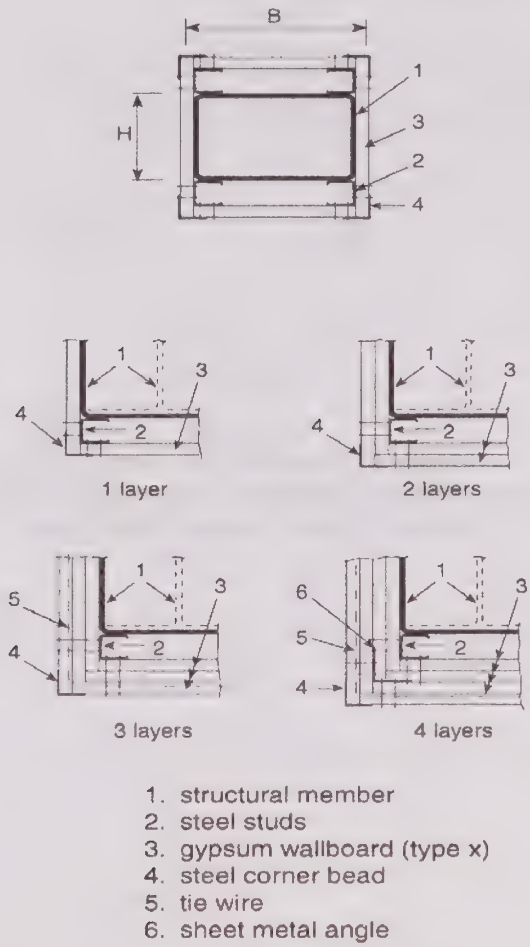


Figure 2.6.4.B.
Columns Protected by Type X Gypsum Wallboard Without Sheet-Steel Membrane

2.6.5. Attachment of Gypsum Wallboard

(1) Where Type X gypsum wallboard is used to protect a steel column without an outside sheet-steel membrane, the method of wallboard attachment to the column shall be as shown in Figure 2.6.4.B. and shall meet the construction details described in Sentences (2) to (7).

(2) The Type X gypsum wallboard shall be applied vertically without horizontal joints.

(3) The first layer of wallboard shall be attached to steel studs with screws spaced not more than 610 mm o.c. and other layers of wallboard shall be attached to steel studs and steel corner beads with screws spaced at a maximum of 305 mm o.c. Where a single layer of wallboard is used, attachment screws shall be spaced not more than 305 mm o.c.

(4) Steel tie wires spaced at a maximum of 610 mm o.c. shall be used to secure the second last layer of wallboard in 3- and 4-layer systems.

(5) Studs shall be fabricated of galvanized steel not less than 0.53 mm thick and not less than 41.3 mm wide, with legs not less than 33.3 mm long and shall be 12.7 mm less than the assembly height.

(6) Corner beads shall
(a) be fabricated of galvanized steel that is not less than 0.41 mm thick,
(b) have legs not less than 31 mm long,
(c) be attached to the wallboard or stud with 25.4 mm screws spaced not more than 305 mm o.c., and
(d) have the attaching fasteners penetrate either another corner bead in multiple layer assemblies or the steel stud member.

(7) In a 4-layer system, metal angles shall be fabricated of galvanized steel and shall be not less than 0.46 mm thick with legs not less than 51 mm long.

2.6.6. Concrete Filled Hollow Steel Columns

(1) A fire-resistance rating, R, is permitted to be assigned to concentrically loaded hollow steel columns that are filled with plain concrete, steel-fibre reinforced concrete or bar-reinforced concrete, that are fabricated and erected within the tolerances stipulated in CSA S16, " Design of Steel Structures", and that comply with Sentences (2) and (3), provided:

$$C \le C_{max}$$

where

C = axial compressive force due to dead and live loads without load factors, kN,

C_{max} = $\left(\dfrac{a\,(f'_c + 20)\,D^{2.5}}{R\,(KL - 1000)}\right)^2$

but shall not exceed

1.0 C'_r for plain concrete filling (PC),
1.1 C'_r for steel-fibre reinforced concrete filling (FC), and
1.7 C'_r for bar-reinforced concrete filling (RC),

where

C'_r = factored compressive resistance of the concrete core in accordance with CSA S16, "Design of Steel Structures",

where

a = constant obtained from Table 2.6.6.A.,

f'_c = specified compressive strength of concrete in accordance with CAN/CSA-A23.3, "Design of Concrete Structures", MPa,

D = outside diameter of a round column or outside width of a square column, mm,

R = specified fire-resistance rating, min, and

KL = effective length of column as defined in CSA S16, "Design of Steel Structures", mm, subject to the validity limits stated in Table 2.6.6.B.

(2) A pair of steam vent holes shall be provided at each end of the hollow steel column and at each intermediate floor level, and the holes shall be
(a) not less than 13 mm in diameter,
(b) located on opposite faces, 150 mm above or below a base plate, cap plate or concrete slab,
(c) orientated so that adjacent pairs are perpendicular, and
(d) not obstructed by other building elements.

(3) Load application and reaction shall be through end bearing in accordance with CSA S16, "Design of Steel Structures".

Table 2.6.6.A.
Values of Constant "a"

Filling Type	Concrete Type[1]	Steel Reinforcement	Circular Columns	Square Columns
PC	S	n/a	0.070	0.060
FC	S	≈ 2%	0.075	0.065
RC	S	1.5% - 3%	0.080	0.070
RC	S	3% - 5%	0.085	0.075
PC	N	n/a	0.080	0.070
FC	N	≈ 2%	0.085	0.075
RC	N	1.5% - 3%	0.090	0.080
RC	N	3% - 5%	0.095	0.085
Column 1	2	3	4	5

Notes to Table 2.6.6.A.:
(1) See Article 1.4., Types of Concrete.

Table 2.6.6.B.
Validity Limits

Parameter	Type of Concrete Filling		
	PC	FC	RC
f'_c (MPa)	20 to 40	20 to 55	20 to 55
D (round) (mm)	140 to 410	120 to 410	165 to 410
D (square) (mm)	140 to 305	102 to 305	175 to 305
Reinforcement (%)	n/a	≈ 2% of the concrete mix by mass	1.5% to 5% of cross-sectional area[1]
Concrete Cover (mm)	n/a	n/a	≥ 25
R (min)	≤120	≤ 180	≤ 180
KL (mm)	2 000 to 4 000	2 000 to 4 500	2 000 to 4 500
Class[2]	1, 2 or 3	1, 2 or 3	1, 2 or 3
Column 1	2	3	4

Notes to Table 2.6.6.B.:
(1) Limits on size, number and spacing of bars and ties in accordance with CAN/CSA-A23.3, "Design of Concrete Structures".
(2) Classification of sections in accordance with CSA S16, "Design of Steel Structures".

2.7. Individually Protected Steel Beams

2.7.1. Minimum Thickness of Protective Covering

(1) The minimum thickness of protective covering on steel beams exposed to fire on 3 sides for fire-resistance ratings from 30 min to 4 h is shown in Table 2.7.1.

2.7.2. Types of Concrete

(1) Concrete is referred to as Type S, N or L, depending on the nature of the aggregate used. This is described in Article 1.4.1.

2.7.3. Effect of Plaster

(1) The effect on fire-resistance ratings of the addition of plaster finish to concrete or masonry beam protection is described in Article 1.7.1.

2.7.4. Exceptions

(1) The fire resistance of protected steel beams depends on the means used to hold the protection in place. Because of the importance of this factor, no rating has been assigned in Table 2.7.1. to masonry units used as protective cover to steel beams. These ratings, however, may be determined on the basis of comparison with column protection at the discretion of the authority having jurisdiction, if satisfactory means of fastening are provided.

Table 2.7.1.
Minimum Thickness of Cover to Individual Protected Steel Beams,(1) mm

Description of Cover	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5	2 h	3 h	4 h
Type S concrete(2) (beam spaces filled solid)	25	25	25	25	32	50	64
Type N or L concrete(2) (beam spaces filled solid)	25	25	25	25	25	39	50
Gypsum-sand plaster on 9.5 mm gypsum lath(3)	13	13	13	20	—	—	—
Gypsum-perlite or vermiculite plaster on 9.5 mm gypsum lath(3)	13	13	13	13	25	—	—
Gypsum-perlite or gypsum-vermiculite on 12.7 mm gypsum lath(3)	13	13	13	20	25	39	50
Gypsum-perlite or vermiculite plaster on double 12.7 mm gypsum lath(3)	13	13	13	20	25	25	39
Portland cement-sand on metal lath(4)	23	23	23	—	—	—	—
Gypsum-sand on metal lath(4) (plaster in contact with lower flange)	16	20	25	39	—	—	—
Gypsum-sand on metal lath with air gap between plaster and lower flange(4)	16	16	16	25	25	—	—
Gypsum-perlite or gypsum-vermiculite on metal lath(4)	16	16	16	23	23	35	48(5)
Column 1	2	3	4	5	6	7	8

Notes to Table 2.7.1.:

(1) Where the thickness of plaster finish applied over gypsum lath is 26 mm or more, the plaster shall be reinforced with wire mesh with 1.57 mm diam wire and 50 mm by 50 mm openings placed midway in the plaster.

(2) Applies to cast-in-place concrete reinforced by 5.21 mm diam wire spaced 200 mm o.c. or 1.57 mm diam wire mesh with 100 mm by 100 mm openings.

(3) Lath held in place by 1.18 mm diam wire wrapped around the gypsum lath 450 mm o.c.

(4) Expanded metal lath 1.63 kg/m^2 fastened to 9.5 mm by 19 mm steel channels held in position by 1.19 mm diam wire.

(5) Plaster finish shall be reinforced with wire mesh with 1.57 mm diam wire and 50 mm by 50 mm openings placed midway in the plaster.

2.7.5. Beam Protected by a Membrane

(1) A steel beam or steel joist assembly that is entirely above a horizontal ceiling membrane will be protected from fire below the membrane and will resist structural collapse for a period equal to the fire-resistance rating determined in conformance with Subsection 2.3. The support for this membrane shall be equivalent to that described in Subsection 2.3. The rating on this basis shall not exceed 1.5 h.

2.8. Reinforced Concrete Columns

2.8.1. Minimum Dimensions

(1) Minimum dimensions for reinforced concrete columns and minimum concrete cover for vertical steel reinforcement are obtained from Articles 2.8.2. to 2.8.5., taking into account the type of concrete, the effective length of the column and the area of the vertical reinforcement.

2.8.2. Method

(1) The minimum dimension, t, in millimetres, of a rectangular reinforced concrete column shall be equal to
(a) 75 f (R + 1) for all Types L and L40S concrete,
(b) 80 f (R + 1) for Type S concrete when the design condition of the concrete column is defined in the second and fourth columns of Table 2.8.2.,
(c) 80 f (R + 0.75) for Type N concrete when the design condition of the concrete column is defined in the second and fourth columns of Table 2.8.2., and
(d) 100 f (R + 1) for Types S and N concrete when the design condition of the concrete column is defined in the third column of Table 2.8.2.

where

f = the value shown in Table 2.8.2.,

R = the required fire-resistance rating in hours,

k = the effective length factor obtained from CAN/CSA-A23.3, "Design of Concrete Structures",

h = the unsupported length of the column in metres, and

p = the area of vertical reinforcement in the column as a percentage of the column area.

(2) The diameter of a round column shall be not less than 1.2 times the value "t" determined in Sentence (1) for a rectangular column.

Table 2.8.2.
Values of Factor " f " [(1)]

Overdesign Factor[(2)]	Values of Factor f to be Used in Applying Article 2.8.2.		
	Where kh is not more than 3.7 m	Where kh is more than 3.7 m but not more than 7.3 m	
		t is not more than 300 mm, p is not more than 3%[(3)]	All other cases[(4)]
1.00	1.00	1.20	1.00
1.25	0.90	1.10	0.90
1.50	0.83	1.00	0.83
Column 1	2	3	4

Notes to Table 2.8.2.:

(1) For conditions that do not fall within the limits described in Table 2.8.2., further information may be obtained from Reference (7) in Subsection 6.1.

(2) Overdesign factor is the ratio of the calculated load carrying capacity of the column to the column strength required to carry the specified loads determined in conformance with CAN/CSA-A23.3, "Design of Concrete Structures".

(3) Where the factor "f" results in a "t" greater than 300 mm, the appropriate factor "f" for "All other cases" shall be applicable.

(4) Where "p" is equal to or less than 3% and the factor "f" results in a "t" less than 300 mm, the minimum thickness shall be 300 mm.

2.8.3. Minimum Thickness of Concrete Cover

(1) Where the required fire-resistance rating of a concrete column is 3 h or less, the minimum thickness in millimetres of concrete cover over vertical steel reinforcement shall be equal to 25 times the number of hours of fire resistance required or 50 mm, whichever is less.

(2) Where the required fire-resistance rating of a concrete column is greater than 3 h, the minimum thickness in millimetres of concrete cover over vertical steel reinforcement shall be equal to 50 plus 12.5 times the required number of hours of fire resistance in excess of 3 h.

(3) Where the concrete cover over vertical steel required in Sentence (2) exceeds 62.5 mm, wire mesh reinforcement with 1.57 mm diameter wire and 100 mm openings shall be incorporated midway in the concrete cover to retain the concrete in position.

2.8.4. Minimum Requirements

(1) The structural design standards may require minimum column dimensions or concrete cover over vertical steel reinforcement differing from those obtained in Sentences 2.8.2.(1) and (2). Where a difference occurs, the greater dimension shall govern.

2.8.5. Addition of Plaster

(1) The addition of plaster finish to the concrete column may be taken into account in determining the cover over vertical steel reinforcement by applying the multiplying factors described in Subsection 1.7. The addition of plaster shall not, however, justify any decrease in the minimum column sizes shown.

2.8.6. Built-in Columns

(1) The fire-resistance rating of a reinforced concrete column that is built into a masonry or concrete wall so that not more than one face may be exposed to the possibility of fire at one time may be determined on the basis of cover to vertical reinforcing steel alone. In order to meet this condition, the wall shall conform to Subsection 2.1. for the fire-resistance rating required.

2.9. Reinforced Concrete Beams

2.9.1. Minimum Cover Thickness

(1) The minimum thickness of cover over principal steel reinforcement in reinforced concrete beams is shown in Table 2.9.1. for fire-resistance ratings from 30 min to 4 h where the width of the beam or joist is at least 100 mm.

Table 2.9.1.
Minimum Cover to Principal Steel Reinforcement in Reinforced Concrete Beams, mm

Type of Concrete	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S, N or L	20	20	20	25	25	39	50
Column 1	2	3	4	5	6	7	8

2.9.2. Maximum Rating

(1) No rating over 2 h may be assigned on the basis of Table 2.9.1. to a beam or joist where the average width of the part that projects below the slab is less than 140 mm, and no rating over 3 h may be assigned where the average width of the part that projects below the slab is less than 165 mm.

2.9.3. Beam Integrated in Floor or Roof Slab

(1) For the purposes of these ratings, a beam may be either independent of or integral with a floor or roof slab assembly.

2.9.4. Minimum Thickness

(1) Where the upper extension or top flange of a joist or T-beam in a floor assembly contributes wholly or partly to the thickness of the slab above, the total thickness at any point shall be not less than the minimum thickness described in Table 2.2.1.A. for the fire-resistance rating required.

2.9.5. Effect of Plaster

(1) The addition of plaster finish to a reinforced concrete beam may be taken into account in determining the cover over principal reinforcing steel by applying the multiplying factors described in Subsection 1.7.

2.10. Prestressed Concrete Beams

2.10.1. Minimum Cross-Sectional Area and Thickness of Cover

(1) The minimum cross-sectional area and thickness of concrete cover over steel tendons in prestressed concrete beams for fire-resistance ratings from 30 min to 4 h are shown in Table 2.10.1.

Table 2.10.1.
Minimum Thickness of Concrete Cover Over Steel Tendons in Prestressed Concrete Beams,[1] mm

Type of Concrete	Area of Beam, cm^2	Fire-Resistance Rating						
		30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S or N	260 to 970	25	39	50	64	—	—	—
	Over 970 to 1 940	25	26	39	45	64	—	—
	Over 1 940	25	26	39	39	50	77	102
Type L	Over 970	25	25	25	39	50	77	102
Column 1	2	3	4	5	6	7	8	9

Notes to Table 2.10.1.:

(1) Where the thickness of concrete cover over the tendons exceeds 64 mm, a wire mesh reinforcement with 1.57 mm diam wire and 100 mm by 100 mm openings shall be incorporated in the beams to retain the concrete in position around the tendons. The mesh reinforcement shall be located midway in the cover.

2.10.2. Minimum Cover Thickness

(1) The cover for an individual tendon shall be the minimum thickness of concrete between the surface of the tendon and the fire-exposed surface of the beam, except that for ungrouted ducts the assumed cover thickness shall be the minimum thickness of concrete between the surface of the duct and the surface of the beam. For beams in which several tendons are used, the cover is assumed to be the average of the minimum cover of the individual tendons. The cover for any individual tendon shall be not less than half the value given in Table 2.10.1. nor less than 25 mm.

2.10.3. Applicability of Ratings

(1) The ratings in Table 2.10.1. apply to a beam that is either independent of or integral with a floor or roof slab assembly. Minimum thickness of slab and minimum cover to steel tendons in prestressed concrete slabs are contained in Subsection 2.2.

2.10.4. Effect of Plaster

(1) The addition of plaster finish to a prestressed concrete beam may be taken into account in determining the cover over steel tendons by applying the multiplying factors described in Subsection 1.7.

2.10.5. Minimum Cover

(1) Except as provided in Sentence (2), in unbonded post- tensioned prestressed concrete beams, the concrete cover to the tendon at the anchor shall be not less than 15 mm greater than the minimum required away from the anchor. The concrete cover to the anchorage bearing plate and to the end of the tendon, if it projects beyond the bearing plate, shall be not less than 25 mm.

(2) The requirements in Sentence (1) do not apply to those portions of beams not likely to be exposed to fire (such as the ends and the tops of flanges of beams immediately below slabs).

2.11. Glued-Laminated Timber Beams and Columns

2.11.1. Applicability of Information

(1) The information in Subsection 2.11. applies to glued-laminated timber beams and columns required to have fire-resistance ratings greater than those afforded under the provisions of Article 3.1.4.6. of Division B of the Building Code.

2.11.2. Method of Calculation

(1) The fire-resistance rating of glued-laminated timber beams and columns in minutes shall be equal to

(a) 0.1 fB [4 - 2(B/D)] for beams which may be exposed to fire on 4 sides,

(b) 0.1 fB [4 - (B/D)] for beams which may be exposed to fire on 3 sides,

(c) 0.1 fB [3 - (B/D)] for columns which may be exposed to fire on 4 sides, and

(d) 0.1 fB [3 - (B/2D)] for columns which may be exposed to fire on 3 sides,

where

f = the load factor shown in Figure 2.11.2.A.,

B = the full dimension of the smaller side of a beam or column in millimetres before exposure to fire (see Figure 2.11.2.B.),

D = the full dimension of the larger side of a beam or column in millimetres before exposure to fire (see Figure 2.11.2.B.),

k = the effective length factor obtained from CSA O86, "Engineering Design in Wood",

L = the unsupported length of a column in millimetres.

(2) The factored resistance of a beam or column shall be determined by using the specified strengths in CSA O86, "Engineering Design in Wood".

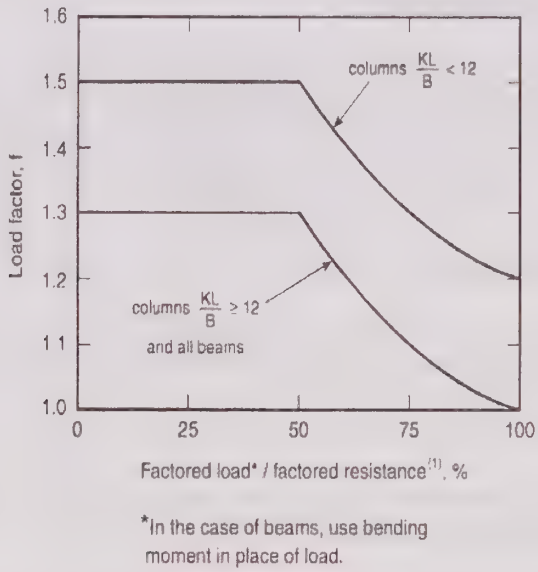


Figure 2.11.2.A.
Factors to Compensate for Partially Loaded Columns and Beams

Note to Figure 2.11.2.A.:

(1) See Sentence 2.11.2.(2).

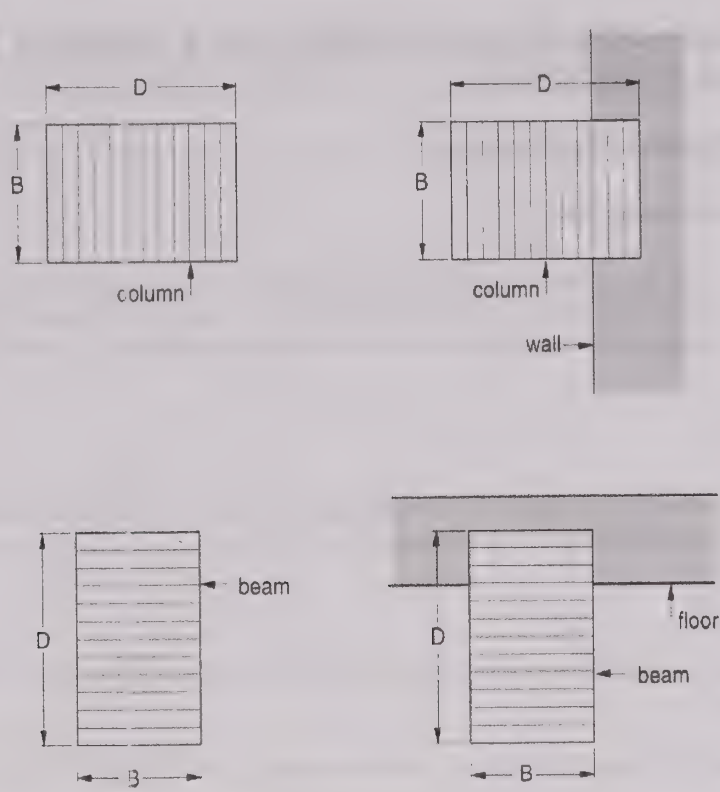


Figure 2.11.2.B.
Full Dimensions of Glued-Laminated Beams and Columns

Section 3 Flame-Spread Ratings and Smoke Developed Classifications

3.1. Interior Finish Materials

3.1.1. Scope of Information

(1) Tables 3.1.1.A. and 3.1.1.B. show flame-spread ratings and smoke developed classifications for combinations of some common interior finish materials. The values are based on all the evidence available at present. Many materials have not been included because of lack of test evidence or because of inability to classify or describe the material in generic terms for the purpose of assigning ratings.

3.1.2. Ratings

(1) The ratings shown in Tables 3.1.1.A. and 3.1.1.B. are arranged in groups corresponding to the provisions of this Code. The ratings apply to materials falling within the general categories indicated.

3.1.3. Table Entries

(1) In Tables 3.1.1.A. and 3.1.1.B., the first number of each entry relates to flame spread and the second number to smoke developed limit. For example:

25/50 represents a flame-spread rating of 0 to 25 and a smoke developed classification of 0 to 50.

150/300 represents a flame-spread rating of 75 to 150 and a smoke developed classification of 100 to 300.

X/X applied to walls and ceilings means a flame-spread rating over 150 and a smoke developed classification over 300.

3.1.4. Effect of Surface Coatings

(1) Thin surface coatings can modify flame-spread characteristics either upward or downward. Table 3.1.1.A. includes a number of thin coatings that increase the flame-spread rating of the base material, so that these may be considered where more precise control over flame spread hazard is desired.

3.1.5. Proprietary Materials

(1) Information on flame-spread rating of proprietary materials and fire-retardant treatments that cannot be described in sufficient detail to ensure reproducibility is available through the listing and labelling services of Underwriters' Laboratories of Canada, Intertek Testing Services NA Ltd. or other recognized testing laboratory.

(2) A summary of flame spread test results published prior to 1965 has been prepared by the Institute for Research in Construction of the National Research Council of Canada (see Item (1) in Subsection 6.1. Fire Test Reports).

Table 3.1.1.A.
Assigned Flame-Spread Ratings and Smoke Developed Classifications for Combinations of Wall and Ceiling Finish Materials and Surface Coatings[1]

Materials	Applicable Material Standard	Minimum Thickness, mm	Surface Coating	
			Unfinished	Paint or Varnish not more than 1.3 mm Thick, Cellulosic Wallpaper not more than One Layer[2][3]
Brick, concrete, tile	None	None		
Steel, copper, aluminum	None	0.33	0/0	25/50
Gypsum plaster	CSA A82.22-M	None		
Gypsum wallboard	CSA A82.27-M ASTM C1396/ C1396M	9.5	25/50	25/50
Lumber	None	16	150/300	150/300
Douglas Fir plywood[4]	CSA O121			
Poplar plywood[4]	CSA O153-M	11	150/100	150/300
Plywood with Spruce face veneer[4]	CSA O151			
Douglas Fir plywood[4]	CSA O121	6	150/100	150/100
Fiberboard low density	CAN/ULC-S706	11	X/100	150/100
Hardboard				
Type 1	CAN/CGSB-11.3-M	9	150/X	[5]
Standard		6	150/300	150/300
Particleboard	ANSI A208.1	12.7	150/300	[5]
Waferboard, OSB	CAN/CSA-O325	—	[5]	[5]
	CSA O437.0	—	[5]	[5]
Column 1	2	3	4	5

Notes to Table 3.1.1.A.:

(1) See Sentence 1.1.1.(5) for standards used to assign flame-spread ratings and smoke developed classifications.
(2) Flame-spread ratings and smoke developed classifications for paints and varnish are not applicable to shellac and lacquer.
(3) Flame-spread ratings and smoke developed classifications for paints apply only to alkyd and latex paints.
(4) The flame-spread ratings and smoke developed classifications shown are for those plywoods without a cellulose resin overlay.
(5) Insufficient test information available.

Table 3.1.1.B.
Flame-Spread Ratings and Smoke Developed Classifications
for Combinations of Common Floor Finish Materials and Surface Coatings(1)

Materials	Applicable Standard	FSR/SDC(2)
Hardwood or softwood flooring either unfinished or finished with a spar or urethane varnish coating	None	300/300
Wool carpet (woven), pile weight not less than 1120 g/m², applied with or without felt underlay(3)	CAN/CGSB-4.129	300/300
Nylon carpet, pile weight not less than 610 g/m² and not more than 800 g/m², applied with or without felt underlay(3)	CAN/CGSB-4.129	300/500
Nylon carpet, pile weight not less than 610 g/m² and not more than 1355 g/m², glued down to concrete	CAN/CGSB-4.129	300/500
Wool/nylon blend carpet (woven) with not more than 20% nylon and pile weight not less than 1120 g/m²	CAN/CGSB-4.129	300/500
Nylon/wool blend carpet (woven) with not more than 50% wool, pile weight not less than 610 g/m² and not more than 800 g/m²	CAN/CGSB-4.129	300/500
Polypropylene carpet, pile weight not less than 500 g/m² and not more than 1200 g/m², glued down to concrete	CAN/CGSB-4.129	300/500
Column 1	2	3

Notes to Table 3.1.1.B.:

(1) Tested on the floor of the tunnel in conformance with provisions of CAN/ULC-S102.2, "Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies".

(2) Flame-Spread Rating/Smoke Developed Classification

(3) Type 1 or 2 underlay as described in CGSB 4-GP-36M, "Carpet Underlay, Fiber Type".

3.1.6. Limitations and Conditions

(1) The propagation of flame along a surface in the standard test involves some finite depth of the material or materials behind the surface, and this involvement extends to the depth to which temperature variations are to be found during the course of the test; for many commonly used lining materials, such as wood, the depth involved is about 25 mm.

(2) For all the combustible materials described in Table 3.1.1.A., a minimum dimension is shown, and this represents the thickness of the test samples on which the rating has been based; when used in greater thicknesses than that shown, these materials may have a slightly lower flame-spread rating, and thinner specimens may have higher flame-spread ratings.

(3) No rating has been included for foamed plastic materials because it is not possible at this time to identify these products with sufficient accuracy on a generic basis. Materials of this type which melt when exposed to the test flame generally show an increase in flame-spread rating as the thickness of the test specimen increases.

3.1.7. Referenced Standards

In Tables 3.1.1.A. and 3.1.1.B., the standards applicable to the materials described are noted because the ratings depend on conformance with these specifications.

Section 4 Noncombustibility

4.1. Test Method

4.1.1. Determination of Noncombustibility

(1) Noncombustibility is required of certain components of buildings by the provisions of this Code, which specifies noncombustibility by reference to CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials".

(2) The test to which reference is made in Sentence (1) is severe, and it may be assumed that any building material containing even a small proportion of combustibles will itself be classified as combustible. The specimen, 38 mm by 51 mm, is exposed to a temperature of 750°C in a small furnace. The essential criteria for noncombustibility are that the specimen does not flame or contribute to temperature rise.

4.2. Materials Classified as Combustible

4.2.1. Combustible Materials

(1) Most materials from animal or vegetable sources will be classed as combustible by CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials", and wood, wood fibreboard, paper, felt made from animal or vegetable fibres, cork, plastics, asphalt and pitch would therefore be classed as combustible.

4.2.2. Composite Materials

(1) Materials that consist of combustible and noncombustible elements in combination will in many cases also be classed as combustible, unless the proportion of combustibles is very small. Some mineral wool insulations with combustible binder, cinder concrete, cement and wood chips and wood-fibred gypsum plaster would also be classed as combustible.

4.2.3. Effect of Chemical Additives

(1) The addition of a fire-retardant chemical is not sufficient to change a combustible product to a noncombustible product.

4.3. Materials Classified as Noncombustible

4.3.1. Typical Examples

(1) Noncombustible materials include brick, ceramic tile, concrete made from Portland cement with noncombustible aggregate, asbestos cement, plaster made from gypsum with noncombustible aggregate, metals commonly used in buildings, glass, granite, sandstone, slate, limestone and marble.

Section 5 Protection of Openings in Fire-Rated Assemblies

5.1. Scope

5.1.1. Installation Information

(1) The information in Section 5 specifies requirements for
(a) the installation of fire doors and fire dampers in gypsum-wallboard-protected stud wall assemblies, and
(b) fire stop flaps for installation in fire-rated membrane ceilings.

5.2. Installation of Fire Doors and Fire Dampers

5.2.1. References

(1) Fire doors and fire dampers in gypsum-wallboard-protected steel stud non-loadbearing walls required to have a fire-resistance rating shall be installed in conformance with Section 9.24. of Division B of the Building Code and the applicable requirements of NFPA 80, "Fire Doors and Other Opening Protectives".

(2) Fire doors and fire dampers in gypsum-wallboard- protected wood stud walls required to have a fire-resistance rating shall be installed in conformance with Section 9.23. of Division B of the Building Code and the applicable requirements of NFPA 80, "Fire Doors and Other Opening Protectives".

5.3. Fire Stop Flaps

5.3.1. Construction Requirements

(1) Fire stop flaps shall be constructed of steel not less than 1.5 mm thick, covered on both sides with painted asbestos paper not less than 1.6 mm thick and equipped with pins and hinges of corrosion-resistant material (see Figure 5.3.1.).

5.3.2. Hold-Open Devices

(1) Fire stop flaps shall be held open with fusible links conforming to ULC-S505, "Fusible Links for Fire Protection Service", or other heat-activated devices having a temperature rating approximately 30°C above the maximum temperature that would exist in the system either with the system in operation or shut down.

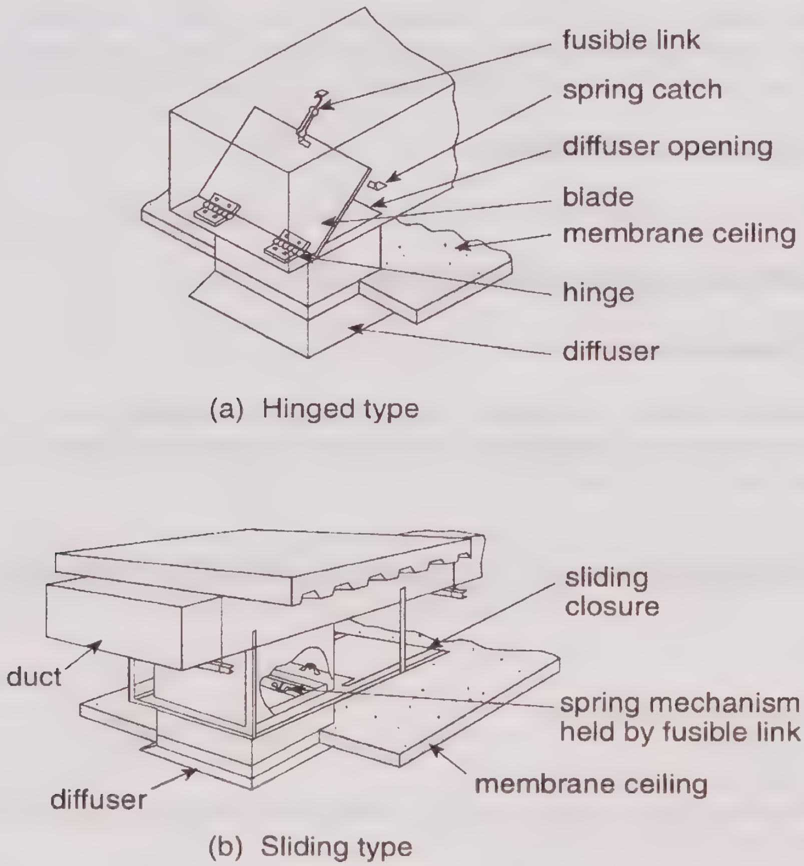


Figure 5.3.1.
Typical Fire Stop Flaps

Section 6 Background Information

6.1. Fire Test Reports

Summaries of available fire test information have been published by the Institute for Research in Construction (formerly the Division of Building Research) as follows:

(1) M. Galbreath, Flame Spread Performance of Common Building Materials. Technical Paper No. 170, Division of Building Research, National Research Council Canada, Ottawa, April 1964. NRCC 7820.

(2) M. Galbreath and W.W. Stanzak, Fire Endurance of Protected Steel Columns and Beams. Technical Paper No. 194, Division of Building Research, National Research Council Canada, Ottawa, April 1965. NRCC 8379.

(3) T.Z. Harmathy and W.W. Stanzak, Elevated-Temperature Tensile and Creep Properties of Some Structural and Prestressing Steels. American Society for Testing and Materials, Special Technical Publication 464, 1970, p. 186 (DBR Research Paper No. 42(4) NRCC 11163.

(4) T.Z. Harmathy, Thermal Performance of Concrete Masonry Walls in Fire. American Society for Testing and Materials, Special Technical Publication 464, 1970, p. 209 (DBR Research Paper No. 42(3) NRCC 11161.

(5) L.W. Allen, Fire Endurance of Selected Non-Loadbearing Concrete Masonry Walls. DBR Fire Study No. 25, Division of Building Research, National Research Council Canada, Ottawa, March 1970. NRCC 11275.

(6) A. Rose, Comparison of Flame Spread Ratings by Radiant Panel, Tunnel Furnace, and Pittsburgh-Corning Apparatus. DBR Fire Study No. 22, Division of Building Research, National Research Council Canada, Ottawa, June 1969. NRCC 10788.

(7) T.T. Lie and D.E. Allen, Calculation of the Fire Resistance of Reinforced Concrete Columns. DBR Technical Paper No. 378, Division of Building Research National Research Council Canada, Ottawa, August 1972. NRCC 12797.

(8) W.W. Stanzak, Column Covers: A Practical Application of Sheet Steel as a Protective Membrane. DBR Fire Study No. 27, Division of Building Research, National Research Council Canada, Ottawa, February 1972. NRCC 12483.

(9) W.W. Stanzak, Sheet Steel as a Protective Membrane for Steel Beams and Columns. DBR Fire Study No. 23, Division of Building Research, National Research Council Canada, Ottawa, November 1969. NRCC 10865.

(10) W.W. Stanzak and T.T. Lie, Fire Tests on Protected Steel Columns with Different Cross-Sections. DBR Fire Study No. 30, Division of Building Research, National Research Council Canada, Ottawa, February 1973. NRCC 13072.

(11) G. Williams-Leir and L.W. Allen, Prediction of Fire Endurance of Concrete Masonry Walls. DBR Technical Paper No. 399, Division of Building Research, National Research Council Canada, Ottawa, November 1973. NRCC 13560.

(12) G. Williams-Leir, Prediction of Fire Endurance of Concrete Slabs. DBR Technical Paper No. 398, Division of Building Research, National Research Council Canada, Ottawa, November 1973. NRCC 13559.

(13) A. Rose, Flammability of Fibreboard Interior Finish Materials. Building Research Note No. 68, Division of Building Research, National Research Council Canada, Ottawa, October 1969.

(14) L.W. Allen, Effect of Sand Replacement on the Fire Endurance of Lightweight Aggregate Masonry Units. DBR Fire Study No. 26, Division of Building Research, National Research Council Canada, Ottawa, September 1971. NRCC 12112.

(15) L.W. Allen, W.W. Stanzak and M. Galbreath, Fire Endurance Tests on Unit Masonry Walls with Gypsum Wallboard. DBR Fire Study No. 32, Division of Building Research, National Research Council Canada, Ottawa, February 1974, NRCC 13901.

(16) W.W. Stanzak and T.T. Lie, Fire Resistance of Unprotected Steel Columns. Journal of Structural Division, Proc., Am. Soc. Civ. Eng., Vol. 99, No. ST5 Proc. Paper 9719, May 1973 (DBR Research Paper No. 577) NRCC 13589.

(17) T.T. Lie and T.Z. Harmathy, Fire Endurance of Concrete-Protected Steel Columns. A.C.I. Journal, January 1974, Title No. 71-4 (DBR Technical Paper No. 597) NRCC 13876.

(18) T.T. Lie, A Method for Assessing the Fire Resistance of Laminated Timber Beams and Columns. Can. J. Civ. Eng., Vol. 4, No. 2, June 1977 (DBR Technical Paper No. 718) NRCC 15946.

(19) T.T. Lie, Calculation of the Fire Resistance of Composite Concrete Floor and Roof Slabs. Fire Technology, Vol. 14, No. 1, February 1978 (DBR Technical Paper No. 77(2) NRCC 16658.

6.2. Obsolete Materials and Assemblies

Building materials, components and structural members and assemblies in buildings constructed before 1995 may have been assigned ratings based on earlier editions of The Supplement to the National Building Code of Canada or older reports of fire tests. To assist users in determining the ratings of these obsolete assemblies and structural members, the following list of reference documents has been prepared. Although some of these publications are out of print, reference copies are available at the Institute for Research in Construction, National Research Council of Canada, Ottawa, Ont., K1A 0R6.

(1) M. Galbreath, Fire Endurance of Unit Masonry Walls. Technical Paper No. 207, Division of Building Research, National Research Council Canada, Ottawa, October 1965. NRCC 8740
(2) M. Galbreath, Fire Endurance of Light Framed and Miscellaneous Assemblies. Technical Paper No. 222, Division of Building Research, National Research Council Canada, Ottawa, June 1966. NRCC 9085.
(3) M. Galbreath, Fire Endurance of Concrete Assemblies. Technical Paper No. 235, Division of Building Research, National Research Council Canada, Ottawa, November 1966. NRCC 9279
(4) Guideline on Fire Ratings of Archaic Materials and Assemblies. Rehabilitation Guideline #8, U.S. Department of Housing and Urban Development, Germantown, Maryland 20767, October
(5) T.Z. Harmathy, Fire Test of a Plank Wall Construction. Fire Study No. 2, Division of Building Research, National Research Council Canada, Ottawa, July 1960. NRCC 5760.
(6) T.Z. Harmathy, Fire Test of a Wood Partition. Fire Study No. 3, Division of Building Research, National Research Council Canada, Ottawa, October 1960. NRCC 5769.

6.3. Assessment of Archaic Assemblies

Information in this document applies to new construction. Please refer to early editions of the Supplement to the National Building Code of Canada for the assessment or evaluation of assemblies that do not conform to the information in this edition of the Building Code. As with other documents, this Code is revised according to the information presented to the standing committee responsible for its content, and with each update new material may be added and material that is not relevant may be deleted.

6.4. Development of the Component Additive Method

The component additive method was developed based upon the following observations and conclusions drawn from published as well as unpublished test information.

Study of the test data showed that structural failure preceded failure by other criteria (transmission of heat or hot gases) in most of the tests of loadbearing wood framed assemblies. The major contributor to fire resistance was the membrane on the fire-exposed side.

Fire tests of wood joist floors without protective ceilings resulted in structural failure between 8 and 10 min. Calculation of the time for wood joists to approach breaking stress, based upon the charring rate of natural woods, suggested a time of 10 min for structural failure. This time was subtracted from the fire-resistance test results of wood joist floors and the remainder considered to be the contribution of the membrane.

The figures obtained for the contribution of membranes were then applied to the test results for open web steel joist floors and wood and steel stud walls and values of 20 min for the contribution of wood stud framing and 10 min for steel framing were derived.

The fire-resistance rating has been limited to 1.5 h as this method of developing ratings for framed assemblies was new and untried. Although this is the subject of current review, no decision has been made to extend the ratings beyond 1.5 h.

(1) M. Galbreath, G. C. Gosselin, and R. B. Chauhan, Historical Guide to Chapter 2 of the Supplement to the National Building Code of Canada, Committee Paper FPR 1-3, Prepared for the Standing Committee on Fire Performance Ratings, May 1987.

Example showing fire-resistance rating of a typical membrane assembly, calculated using the component additive method.

1 hour Gypsum Board/Wood Stud Interior Partition

A 1 h fire-resistance rating is required for an interior wood framed partition, using 12.7 mm Type X gypsum wallboard.

(a) Since gypsum wallboard is used (Sentence 2.3.4.(2) and Table 2.3.4.A.) time assigned to 12.7 mm Type X gypsum wallboard membrane on the fire-exposed side of the partition = 25 min

(b) Time assigned to wood framing members at 406 mm o.c. (Sentence 2.3.4.(3) and Table 2.3.4.C.) = 20 min

(c) Time assigned to insulation, if the spaces between the studs are filled with preformed insulation of rock or slag fibres conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings", (Sentence 2.3.4.(4) and Table 2.3.4.D.) = 15 min

(d) Time assigned to the membrane on the non- fire-exposed side (Sentence 2.3.5.(1)) = 0 min
Fire-resistance rating = 25 + 20 + 15 = 60 min

SB-3 Fire and Sound Resistance of Building Assemblies

(This Standard is based in large measure on Appendix A of the National Building Code of Canada 2010)

The following Tables may be used to select building assemblies for compliance with Article 9.10.3.1. and Subsection 9.11.2. of Division B of the 2012 Building Code.

Tables 1 and 2 have been developed from information gathered from tests. While a large number of the assemblies listed were tested, the fire-resistance and acoustical ratings for others were assigned on the basis of extrapolation of information from tests of similar assemblies. Where there was enough confidence relative to the fire performance of an assembly, the fire-resistance ratings were assigned relative to the commonly used minimum ratings of 30 min, 45 min and 1 h, including a designation of "< 30 min" for assemblies that are known not to meet the minimum 30-minute rating. Where there was not enough comparative information on an assembly to assign to it a rating with confidence, its value in the Tables has been left blank (hyphen), indicating that its rating remains to be assessed through another means. Future work is planned to develop much of this additional information.

These Tables are provided only for the convenience of Code users and do not limit the number of assemblies permitted to those in the Tables. Assemblies not listed or not given a rating in these Tables are equally acceptable provided their fire and sound resistance can be demonstrated to meet the above-noted requirements either on the basis of tests referred to in Article 9.10.3.1. and Subsection 9.11.1. or by using the data in MMAH Supplementary Standard SB-2, "Fire-Performance Ratings". It should be noted, however, that Tables 1 and 2 of this Supplementary Standard are not based on the same assumptions as those used in MMAH Supplementary Standard SB-2. Assemblies in Tables 1 and 2 are described through their generic descriptions and variants and include details given in the notes to the Tables. Assumptions for MMAH Supplementary Standard SB-2 include different construction details that must be followed rigorously for the calculated ratings to be expected. These are two different methods of choosing assemblies that meet required fire ratings.

Table 2 presents fire-resistance and acoustical ratings for floor, ceiling and roof assemblies. The fire-resistance ratings are appropriate for all assemblies conforming to the construction specifications given in Table 2, including applicable Table notes. Acoustical ratings for assemblies decrease with decreasing depth and decreasing separation of the structural members; the values listed for sound transmission class and impact insulation class are suitable for the minimum depth of structural members identified in the description, including applicable table notes, and for structural member spacing of 305 mm o.c., unless other values are explicitly listed for the assembly. Adjustments to the acoustical ratings to allow for the benefit of deeper or more widely spaced structural members are given in Table Notes (8) and (9).

Section 1 Fire and Sound Resistance of Walls

Table 1
Fire and Sound Resistance of Walls

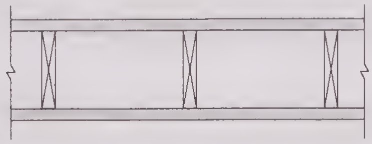
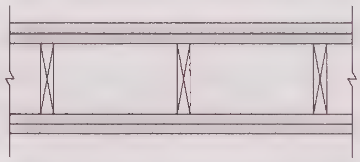
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
• Wood Studs • Single Row • Loadbearing or Non-Loadbearing	**W1**	• 38 mm x 89 mm wood studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side			
	W1a	W1 with • 89 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	1 h	1 h	36
	W1b	W1 with • 89 mm thick absorptive material[4] • 12.7 mm Type X gypsum board[5]	45 min [1 h][6]	45 min [1 h][6]	34
	W1c	W1 with • 89 mm thick absorptive material[4] • 12.7 mm regular gypsum board[5][7]	30 min	30 min [45 min][6]	32
	W1d	W1 with • no absorptive material • 15.9 mm Type X gypsum board[5]	1 h	1 h	32
	W1e	W1 with • no absorptive material • 12.7 mm Type X gypsum board[5]	45 min	45 min	32
	W2	• 38 mm x 89 mm wood studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 2 layers of gypsum board on each side			
	W2a	W2 with • 89 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	1.5 h	2 h	38
	W2b	W2 with • 89 mm thick absorptive material[4] • 12.7 mm Type X gypsum board[5]	1 h	1.5 h	38
	W2c	W2 with • 89 mm thick absorptive material[4] • 12.7 mm regular gypsum board[5]	45 min	1 h	36
	W2d	W2 with • no absorptive material • 15.9 mm Type X gypsum board[5]	1.5 h	2 h	36
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

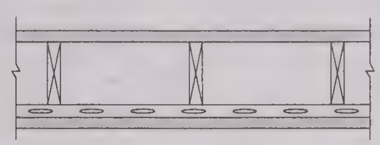
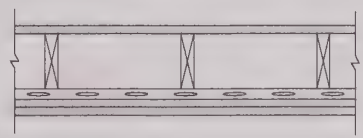
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
	W2e	W2 with • no absorptive material • 12.7 mm Type X gypsum board[5]	1 h	1.5 h	35
	W2f	W2 with • no absorptive material • 12.7 mm regular gypsum board[5]	45 min	1 h	34
	W3	• 38 mm x 89 mm wood studs spaced 406 mm or 610 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels on one side spaced 406 mm or 610 mm o.c. • 1 layer of gypsum board on each side			
	W3a	W3 with • studs spaced 406 mm o.c. • 15.9 mm Type X gypsum board[5]	45 min	1 h	45
• Wood Studs • Single Row • Loadbearing or Non-Loadbearing	W3b	W3 with • studs spaced 610 mm o.c. • 15.9 mm Type X gypsum board[5]	45 min	1 h	48
	W3c	W3 with • studs spaced 406 mm or 610 mm o.c. • 12.7 mm Type X gypsum board[5]	45 min	45 min	43
	W4	• 38 mm x 89 mm wood studs spaced 406 mm or 610 mm o c. • 89 mm thick absorptive material[4] • resilient metal channels on one side spaced 406 mm or 610 mm o.c. • 2 layers of gypsum board on resilient metal channel side • 1 layer of gypsum board on other side			
	W4a	W4 with • studs spaced 406 mm o.c. • 15.9 mm Type X gypsum board[5]	1 h	1 h [1.5 h][6]	51
	W4b	W4 with • studs spaced 610 mm o.c. • 15.9 mm Type X gypsum board[5]	1 h	1 h [1.5 h][6]	54
	W4c	W4 with • studs spaced 406 mm o.c. • 12.7 mm Type X gypsum board[5]	45 min [1 h][6]	1 h	49
	W4d	W4 with • studs spaced 610 mm o.c. • 12.7 mm Type X gypsum board[5]	45 min [1 h][6]	1 h	53
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

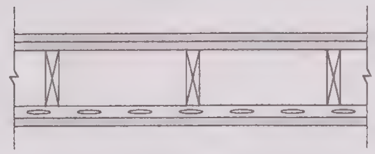
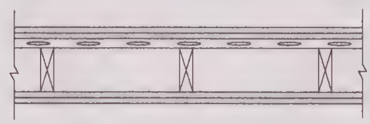
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
• Wood Studs • Single Row • Loadbearing or Non-Loadbearing	**W5**	• 38 mm x 89 mm wood studs spaced 406 mm or 610 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels on one side spaced 406 mm or 610 mm o.c. • 1 layer of gypsum board on resilient metal channel side • 2 layers of gypsum board on other side			
	W5a	W5 with • studs spaced 406 mm o.c. • 15.9 mm Type X gypsum board[5]	45 min	1 h	51
	W5b	W5 with • studs spaced 610 mm o.c. • 15.9 mm Type X gypsum board[5]	45 min	1 h	54
	W5c	W5 with • studs spaced 406 mm o.c. • 12.7 mm Type X gypsum board[5]	45 min	1 h	49
	W5d	W5 with • studs spaced 610 mm o.c. • 12.7 mm Type X gypsum board[5]	45 min	1 h	53
	W6	• 38 mm x 89 mm wood studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • resilient metal channels on one side • 2 layers of gypsum board on each side			
	W6a	W6 with • studs spaced 406 mm or 610 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels spaced 406 mm o.c. • 15.9 mm Type X gypsum board[5]	1.5 h	2 h	55
	W6b	W6 with • studs spaced 406 mm or 610 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels spaced 610 mm o.c. • 15.9 mm Type X gypsum board[5]	1.5 h	2 h	58
	W6c	W6 with • studs spaced 406 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels spaced 406 mm o.c. • 12.7 mm Type X gypsum board[5]	1 h	1.5 h	53
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Wood Studs • Single Row • Loadbearing or Non-Loadbearing	W6d	W6 with • studs spaced 406 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 610 mm o.c. • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	55
	W6e	W6 with • studs spaced 610 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 406 mm o.c. • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	55
	W6f	W6 with • studs spaced 610 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 610 mm o.c. • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	58
	W6g	W6 with • studs spaced 406 mm or 610 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 406 mm o.c. • 12.7 mm regular gypsum board(5)	45 min	1 h	50
	W6h	W6 with • studs spaced 406 mm or 610 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 610 mm o.c. • 12.7 mm regular gypsum board(5)	45 min	1 h	52
	W6i	W6 with • studs spaced 406 mm or 610 mm o.c. • no absorptive material • resilient metal channels spaced 406 mm or 610 mm o.c. • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	47
	W6j	W6 with • studs spaced 406 mm or 610 mm o.c. • no absorptive material • resilient metal channels spaced 406 mm or 610 mm o.c. • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	46
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

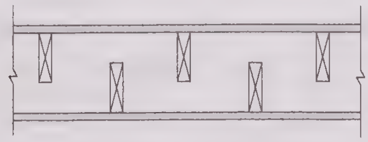
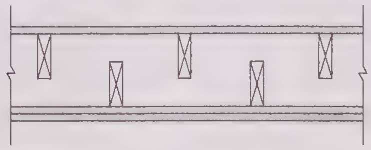
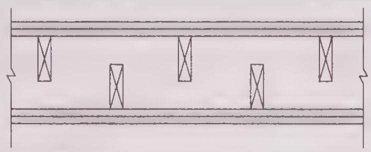
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Wood Studs • Two Rows Staggered on 38 mm x 140 mm plate • Loadbearing or Non-Loadbearing	**W7**	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. staggered on common 38 mm x 140 mm plate • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 1 layer of gypsum board on each side			
	W7a	W7 with • 15.9 mm Type X gypsum board(5)	1 h	1 h	47
	W7b	• W7 with • 12.7 mm Type X gypsum board(5)	45 min [1 h](6)	45 min [1 h](6)	45
	W7c	W7 with • 12.7 mm regular gypsum board(5)(7)	30 min	30 min [45 min](6)	42
	W8	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. staggered on common 38 mm x 140 mm plate • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 2 layers of gypsum board on one side • 1 layer of gypsum board on other side			
	W8a	W8 with • 15.9 mm Type X gypsum board(5)	1 h	1.5 h	52
	W8b	W8 with • 12.7 mm Type X gypsum board(5)	45 min	1 h	50
	W9	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. staggered on common 38 mm x 140 mm plate • with or without absorptive material • 2 layers of gypsum board on each side			
	W9a	W9 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	56
	W9b	W9 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	55
	W9c	W9 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 12.7 mm regular gypsum board(5)	45 min	1 h	53
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

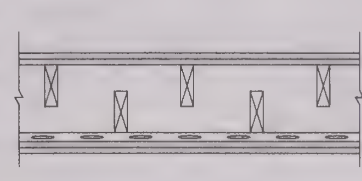
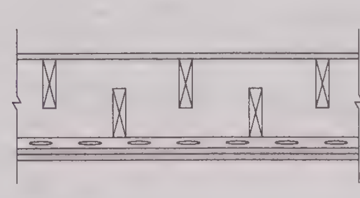
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
	W9d	W9 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	48
	W10	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. staggered on common 38 mm x 140 mm plate • with or without absorptive material • resilient metal channels on one side spaced 406 mm or 610 mm o.c. • 2 layers of gypsum board on each side			
	W10a	W10 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	62
• Wood Studs • Two Rows Staggered on 38 mm x 140 mm plate • Loadbearing or Non-Loadbearing	W10b	W10 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	60
	W10c	W10 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	50
	W10d	W10 with • no absorptive material • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	48
	W11	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. staggered on common 38 mm x 140 mm plate • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • resilient metal channels on one side spaced 406 mm or 610 mm o.c. • 2 layers of gypsum board on resilient channel side • 1 layer of gypsum board on other side			
	W11a	W11 with • 15.9 mm Type X gypsum board(5)	1 h	1 h	56
	W11b	W11 with • 12.7 mm Type X gypsum board(5)	45 min [1 h](6)	1 h	54
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

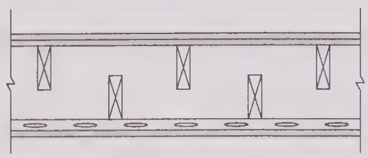
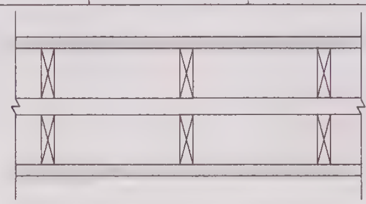
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Wood Studs • Two Rows Staggered on 38 mm x 140 mm plate • Loadbearing or Non-Loadbearing	**W12**	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. staggered on common 38 mm x 140 mm plate • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • resilient metal channels on one side spaced 406 mm or 610 mm o.c. • 1 layer of gypsum board on resilient metal channel side • 2 layers of gypsum board on other side			
	W12a	W12 with • 15.9 mm Type X gypsum board(5)	45 min	1 h	56
	W12b	W12 with • 12.7 mm Type X gypsum board(5)	45 min	1 h	54
• Wood Studs • Two Rows on Separate Plates • Loadbearing or Non-Loadbearing	**W13**	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. on separate 38 mm x 89 mm plates set 25 mm apart • with or without absorptive material • 1 layer of gypsum board on each side			
	W13a	W13 with • 89 mm thick absorptive material on each side(4)(8) • 15.9 mm Type X gypsum board(5)	1 h	1 h	57
	W13b	W13 with • 89 mm thick absorptive material on each side(4)(8) • 12.7 mm Type X gypsum board(5)	45 min [1 h](6)	45 min [1 h](6)	57
	W13c	W13 with • 89 mm thick absorptive material on one side only(4)(8) • 15.9 mm Type X gypsum board(5)	1 h	1 h	54
	W13d	W13 with • 89 mm thick absorptive material on one side only(4)(8) • 12.7 mm Type X gypsum board(5)	45 min	45 min	53
	W13e	W13 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1 h	1 h	45
	W13f	W13 with • no absorptive material • 12.7 mm Type X gypsum board(5)	45 min	45 min	45
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

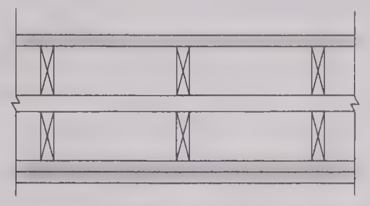
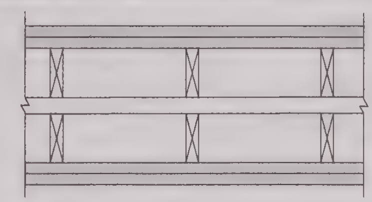
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
• Wood Studs • Two Rows on Separate Plates • Loadbearing or Non-Loadbearing	**W14**	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. on separate 38 mm x 89 mm plates set 25 mm apart • with or without absorptive material • 2 layers of gypsum board on one side • 1 layer of gypsum board on other side			
	W14a	W14 with • 89 mm thick absorptive material on each side[4][8] • 15.9 Type X gypsum board[5]	1 h	1 h [1.5 h][6]	61
	W14b	W14 with • 89 mm thick absorptive material on each side[4][8] • 12.7 Type X gypsum board[5]	45 min	1 h	61
	W14c	W14 with • 89 mm thick absorptive material on one side only[4][8] • 15.9 Type X gypsum board[5]	1 h	1 h	57
	W14d	W14 with • 89 mm thick absorptive material on one side only[4][8] • 12.7 Type X gypsum board[5]	45 min	1 h	57
	W14e	W14 with • no absorptive material • 15.9 Type X gypsum board[5]	1 h	1 h	51
	W14f	W14 with • no absorptive material • 12.7 Type X gypsum board[5]	45 min	1 h	51
	W15	• two rows 38 mm x 89 mm wood studs each spaced 406 mm or 610 mm o.c. on separate 38 mm x 89 mm plates set 25 mm apart • with or without absorptive material • 2 layers of gypsum board on each side			
	W15a	W15 with • 89 mm thick absorptive material on each side[4][8] • 15.9 mm Type X gypsum board[5]	1.5 h	2 h	66
	W15b	W6 with • 89 mm thick absorptive material on each side[4][8] • 12.7 mm Type X gypsum board[5]	1 h	1.5 h	65
	W15c	W15 with • 89 mm thick absorptive material on each side[4][8] • 12.7 mm regular gypsum board[5]	45 min	1 h	61
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

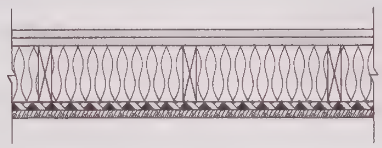
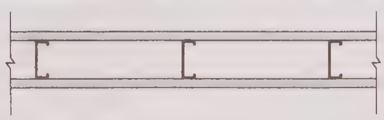
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
• Wood Studs • Two Rows on Separate Plates • Loadbearing or Non-Loadbearing	W15d	W15 with • 89 mm thick absorptive material on one side only[4][8] • 15.9 mm Type X gypsum board[5]	1.5 h	2 h	62
	W15e	W15 with • 89 mm thick absorptive material on one side only[4][8] • 12.7 mm Type X gypsum board[5]	1 h	1.5 h	60
	W15f	W15 with • 89 mm thick absorptive material on one side only[4][8] • 12.7 mm regular gypsum board[5]	45 min	1 h	57
	W15g	W15 with • no absorptive material • 15.9 mm Type X gypsum board[5]	1.5 h	2 h	56
	W15h	W15 with • no absorptive material • 12.7 mm Type X gypsum board[5]	1 h	1.5 h	55
	W15i	W15 with • no absorptive material • 12.7 mm regular gypsum board[5]	45 min	1 h	51
• Exterior Wood Studs • Single Row • Loadbearing and Non-Loadbearing	**EW1**	• 38 mm x 89 mm wood studs spaced 406 mm or 610 mm o.c. • 89 mm thick absorptive material[6] • 1 or 2 layers of gypsum board on inside • exterior sheathing and siding			
	EW1a	EW1 with • 15.9 mm Type X gypsum board[5][9]	1 h	1 h	N/A
	EW1b	EW1 with • 12.7 mm Type X gypsum board[5][9]	45 min	45 min	N/A
	EW1c	EW1 with • 2 layers of 12.7 mm regular gypsum board[5][9]	45 min	45 min	N/A
• Non-Loadbearing Steel Studs • 0.46 mm (25 Gauge)	**S1**	• 31 mm x 64 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side			
	S1a	S1 with • studs spaced 610 mm o.c. • 65 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	—	45 min [1 h][6]	43
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

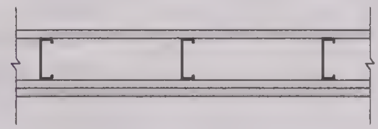
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
	S1b	S1 with • studs spaced 406 mm o.c. • 65 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	—	45 min [1 h][6]	39
	S1c	S1 with • studs spaced 406 mm or 610 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	—	45 min	35
	S2	• 31 mm x 64 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on one side • 2 layers of gypsum board on other side			
	S2a	S2 with • studs spaced 610 mm o.c. • 65 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	—	1 h	50
• Non-Loadbearing Steel Studs	S2b	S2 with • studs spaced 406 mm o.c. • 65 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	—	1 h	44
• 0.46 mm (25 Gauge)	S2c	S2 with • studs spaced 610 mm o.c. • 65 mm thick absorptive material[4] • 12.7 mm Type X gypsum board[5]	—	1 h	50
	S2d	S2 with • studs spaced 406 mm o.c. • 65 mm thick absorptive material[4] • 12.7 mm Type X gypsum board[5]	—	1 h	42
	S2e	S2 with • studs spaced 610 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	—	1 h	41
	S2f	S2 with • studs spaced 406 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	—	1 h	37
	S2g	S2 with • studs spaced 610 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board[5]	—	1 h	40
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

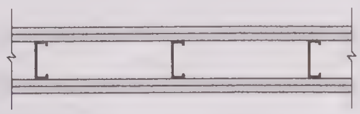
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
	S2h	S2 with • studs spaced 406 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	—	1 h	35
	S3	• 31 mm x 64 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 2 layers of gypsum board on each side			
	S3a	S3 with • studs spaced 610 mm o.c. • 65 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	2 h	54
	S3b	S3 with • studs spaced 406 mm o.c. • 65 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	2 h	51
• Non-Loadbearing Steel Studs • 0.46 mm (25 Gauge)	S3c	S3 with • studs spaced 610 mm o.c. • 65 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	—	1.5 h	53
	S3d	S3 with • studs spaced 406 mm o.c. • 65 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	—	1.5 h	47
	S3e	S3 with • studs spaced 610 mm o.c. • 65 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	—	1 h	49
	S3f	S3 with • studs spaced 406 mm o.c. • 65 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	—	1 h	41
	S3g	S3 with • studs spaced 610 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	—	2 h	45
	S3h	S3 with • studs spaced 406 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	—	2 h	42
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

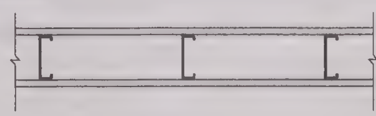
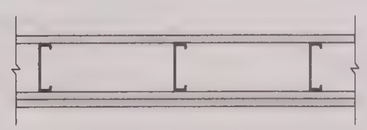
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
	S3i	S3 with • studs spaced 610 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board[5]	—	1.5 h	44
	S3j	S3 with • studs spaced 406 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board[5]	—	1.5 h	39
	S3k	S3 with • studs spaced 610 mm o.c. • no absorptive material • 12.7 mm regular gypsum board[5]	—	1 h	40
	S3l	S3 with • studs spaced 406 mm o.c. • no absorptive material • 12.7 mm regular gypsum board[5]	—	1 h	37
• Non-Loadbearing Steel Studs • 0.46 mm (25 Gauge)	**S4**	• 31 mm x 92 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side			
	S4a	S4 with • studs spaced 610 mm o.c. • 89 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	—	45 min [1 h][6]	48
	S4b	S4 with • studs spaced 406 mm o.c. • 89 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	—	45 min [1 h][6]	47
	S4c	S4 with • studs spaced 610 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	—	45 min	38
	S4d	S4 with • studs spaced 406 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	—	45 min	38
	S5	• 31 mm x 92 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on one side • 2 layers of gypsum board on other side			
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

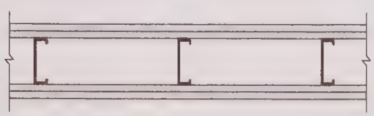
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Non-Loadbearing Steel Studs • 0.46 mm (25 Gauge)	S5a	S5 with • studs spaced 610 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	1 h [1.5 h](6)	53
	S5b	S5 with • studs spaced 406 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	1 h [1.5 h](6)	52
	S5c	S5 with • studs spaced 610 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	—	1 h [1.5 h](6)	51
	S5d	S5 with • studs spaced 406 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	—	1 h [1.5 h](6)	50
	S5e	S5 with • studs spaced 610 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	—	1 h	43
	S5f	S5 with • studs spaced 406 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	—	1 h	42
	S5g	S5 with • studs spaced 610 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	—	1 h	41
	S5h	S5 with • studs spaced 406 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	—	1 h	40
	S6	• 31 mm x 92 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 2 layers of gypsum board on each side			
	S6a	S6 with • studs spaced 610 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	2 h	56
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Non-Loadbearing Steel Studs • 0.46 mm (25 Gauge)	S6b	S6 with • studs spaced 406 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	2 h	55
	S6c	S6 with • studs spaced 610 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	—	1.5 h	55
	S6d	S6 with • studs spaced 406 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	—	1.5 h	54
	S6e	S6 with • studs spaced 610 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	—	1 h	50
	S6f	S6 with • studs spaced 406 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	—	1 h	48
	S6g	S6 with • studs spaced 610 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	—	2 h	47
	S6h	S6 with • studs spaced 406 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	—	2 h	45
	S6i	S6 with • studs spaced 610 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	—	1.5 h	45
	S6j	S6 with • studs spaced 406 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	—	1.5 h	44
	S6k	S6 with • studs spaced 610 mm o.c. • no absorptive material • 12.7 mm regular gypsum board(5)	—	1 h	41
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

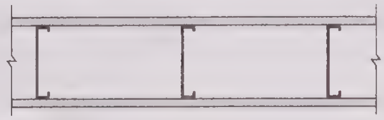
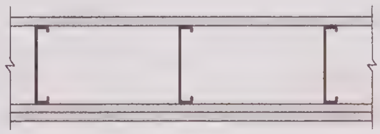
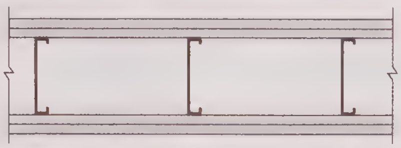
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Non-Loadbearing Steel Studs • 0.46 mm (25 Gauge)	S6l	S6 with • studs spaced 406 mm o.c. • no absorptive material • 12.7 mm regular gypsum board(5)	—	1 h	39
	S7	• 31 mm x 152 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side			
	S7a	S7 with • 150 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	45 min [1 h](6)	51
	S7b	S7 with • no absorptive material • 15.9 mm Type X gypsum board(5)	—	45 min	41
	S8	• 31 mm x 152 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on one side • 2 layers of gypsum board on other side			
	S8a	S8 with • 150 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	1 h [1.5 h](6)	55
	S8b	S8 with • 150 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	—	1 h [1.5 h](6)	54
	S8c	S8 with • no absorptive material • 15.9 mm Type X gypsum board(5)	—	1 h	45
	S8d	S8 with • no absorptive material • 12.7 mm Type X gypsum board(5)	—	1 h	44
	S9	• 31 mm x 152 mm steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • 2 layers of gypsum board on each side			
	S9a	S9 with • 150 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	—	2 h	59
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

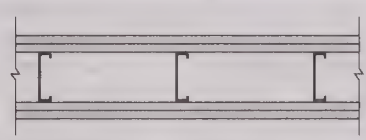
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Non-Loadbearing Steel Studs • 0.46 mm (25 Gauge)	S9b	S9 with • 150 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	—	1.5 h	57
	S9c	S9 with • 150 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	—	1 h	53
	S9d	S9 with • no absorptive material • 15.9 mm Type X gypsum board(5)	—	2 h	49
	S9e	S9 with • no absorptive material • 12.7 mm Type X gypsum board(5)	—	1.5 h	47
	S9f	S9 with • no absorptive material • 12.7 mm regular gypsum board(5)	—	1 h	43
• Loadbearing Steel Studs • 0.84 mm to 1.52 mm thickness	**S10**	• 41 mm x 92 mm loadbearing steel studs spaced 406 mm or 610 mm o.c. • with or without cross-bracing on one side • with or without absorptive material • 2 layers of gypsum board on each side			
	S10a	S10 with • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	1 h	—	38
	S10b	S10 with • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	45 min [1 h](6)	—	38
	S10c	S10 with • 89 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	—	—	36
	S10d	S10 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1 h	—	36
	S10e	S10 with • no absorptive material • 12.7 mm Type X gypsum board(5)	1 h	—	35
	S10f	S10 with • no absorptive material • 12.7 mm regular gypsum board(5)	—	—	34
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

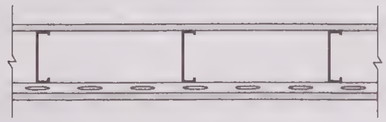
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Loadbearing Steel Studs • 0.84 mm to 1.52 mm thickness	**S11**	• 41 mm x 92 mm loadbearing steel studs spaced 406 mm or 610 mm o.c. • with or without cross-bracing on one side • with or without absorptive material • resilient metal channels on one side • 1 layer of gypsum board on each side			
	S11a	S11 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 610 mm o.c. • 15.9 mm Type X gypsum board(5)	—	—	50
	S11b	S11 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 406 mm o.c. • 15.9 mm Type X gypsum board(5)	—	—	47
	S11c	S11 with • no absorptive material • resilient metal channels spaced at 610 mm o.c. • 15.9 mm Type X gypsum board(5)	—	—	41
	S11d	S11 with • no absorptive material • resilient metal channels spaced at 406 mm o.c. • 15.9 mm Type X gypsum board(5)	—	—	39
	S11e	S11 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 610 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	47
	S11f	S11 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 406 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	45
	S11g	S11 with • no absorptive material • resilient metal channels spaced at 610 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	38
	S11h	S11 with • no absorptive material • resilient metal channels spaced at 406 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	36
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

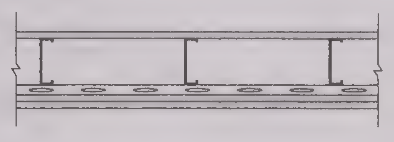
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Loadbearing Steel Studs • 0.84 mm to 1.52 mm thickness	**S12**	• 41 mm x 92 mm loadbearing steel studs spaced 406 mm or 610 mm o.c. • with or without cross-bracing on one side • with or without absorptive material • resilient metal channels on one side • 2 layers of gypsum board on resilient channel side • 1 layer of gypsum board on other side			
	S12a	S12 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 610 mm o.c. • 15.9 mm Type X gypsum board(5)	—	—	54
	S12b	S12 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 406 mm o.c. • 15.9 mm Type X gypsum board(5)	—	—	52
	S12c	S12 with • no absorptive material • resilient metal channels spaced at 610 mm o.c. • 15.9 mm Type X gypsum board(5)	—	—	46
	S12d	S12 with • no absorptive material • resilient metal channels spaced at 406 mm o.c. • 15.9 mm Type X gypsum board(5)	—	—	43
	S12e	S12 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 610 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	52
	S12f	S12 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 406 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	50
	S12g	S12 with • no absorptive material • resilient metal channels spaced at 610 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	43
	S12h	S12 with • no absorptive material • resilient metal channels spaced at 406 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	41
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

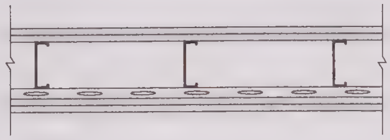
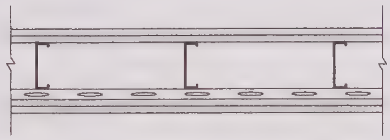
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Loadbearing Steel Studs • 0.84 mm to 1.52 mm thickness	**S13**	• 41 mm x 92 mm loadbearing steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • resilient metal channels on one side spaced at 406 mm o.c. • 2 layers of gypsum board on resilient channel side • 1 layer shear membrane and 1 layer gypsum board on other side			
	S13a	S13 with • 89 mm thick absorptive material(4) • 12.7 mm OSB shear membrane • 15.9 mm Type X gypsum board(5)	30 min	—	57
	S14	• 41 mm x 92 mm loadbearing steel studs spaced 406 mm or 610 mm o.c. • with or without absorptive material • resilient metal channels on one side • 2 layers of gypsum board on each side			
	S14a	S14 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 610 mm o.c. • 15.9 mm Type X gypsum board(5)	1 h	—	60
	S14b	S14 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 610 mm o.c. • 12.7 mm Type X gypsum board(5)	45 min [1 h](6)	—	57
	S14c	S14 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 610 mm o.c. • 12.7 mm regular gypsum board(5)	—	—	54
	S14d	S14 with • no absorptive material • resilient metal channels spaced at 610 mm o.c. • 15.9 mm Type X gypsum board(5)	1 h	—	51
	S14e	S14 with • no absorptive material • resilient metal channels spaced at 610 mm o.c. • 12.7 mm Type X gypsum board(5)	—	—	45
	S14f	S14 with • 89 mm thick absorptive material(4) • resilient metal channels spaced at 406 mm o.c. • 12.7 mm Type X gypsum board(5)	45 min [1 h](6)	—	55
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

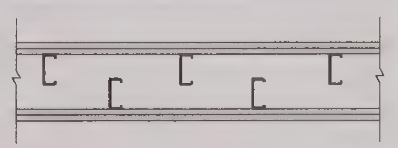
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
• Loadbearing Steel Studs • 0.84 mm to 1.52 mm thickness	S14g	S14 with • no absorptive material • resilient metal channels spaced at 406 mm o.c. • 12.7 mm Type X gypsum board[5]	1 h	—	47
	S14h	S14 with • studs at 610 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels spaced at 406 mm o.c. • 15.9 mm Type X gypsum board[5]	1 h	—	60
	S14i	S14 with • studs at 406 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels spaced at 406 mm o.c. • 15.9 mm Type X gypsum board[5]	1 h	—	58
	S14j	S14 with • studs at 610 mm o.c. • no absorptive material • resilient metal channels spaced at 406 mm o.c. • 15.9 mm Type X gypsum board[5]	1 h	—	51
	S14k	S14 with • studs at 406 mm o.c. • no absorptive material • resilient metal channels spaced at 406 mm o.c. • 15.9 mm Type X gypsum board[5]	1 h	—	49
	S14l	S14 with • studs at 406 mm o.c. • no absorptive material • resilient metal channels spaced at 610 mm o.c. • 12.7 mm Type X gypsum board[5]	1 h	—	49
	S14m	S14 with • studs at 610 mm o.c. • no absorptive material • resilient metal channels spaced at 610 mm o.c. • 12.7 mm regular gypsum board[5]	1 h	—	50
	S15	• 2 rows of 41 mm x 92 mm loadbearing steel studs spaced 406 mm or 610 mm o.c. • with cross bracing • with or without absorptive material • 2 layers of gypsum board on each side			
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

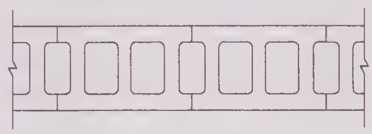
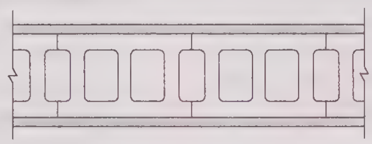
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Loadbearing Steel Studs • 0.84 mm to 1.52 mm thickness	S15a	S15 with • 89 mm thick absorptive material in each cavity • 15.9 mm Type X gypsum board(5)	1 h	—	68
	S15b	S15 with • 89 mm thick absorptive material in each cavity • 12.7 mm Type X gypsum board(5)	1 h	—	68
	S15c	S15 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1 h	—	52
	S15d	S15 with • no absorptive material • 12.7 mm Type X gypsum board(5)	1 h	—	52
• Hollow Concrete Block (Normal Weight Aggregate)	**B1**	• 140 mm or 190 mm concrete block			
	B1a	• 140 mm bare concrete block(3)	1 h	1 h	48
	B1b	• 190 mm bare concrete block(3)	1.5 h	1.5 h	50
	B2	• 140 mm or 190 mm concrete block • no absorptive material • 1 layer of gypsum-sand plaster or gypsum board on each side			
	B2a	B2 with • 140 mm concrete block • 12.7 mm gypsum-sand plaster	2 h	2 h	50
	B2b	B2 with • 140 mm concrete block • 12.7 mm Type X gypsum board or 15.9 mm Type X gypsum board(5)	2 h	2 h	47
	B2c	B2 with • 140 mm concrete block • 12.7 mm regular gypsum board(5)	1.5 h	1.5 h	46
	B2d	B2 with • 190 mm concrete block • 12.7 mm gypsum-sand plaster	2.5 h	2.5 h	51
	B2e	B2 with • 190 mm concrete block • 15.9 mm Type X gypsum board(5)	3 h	3 h	50
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

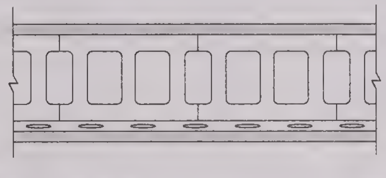
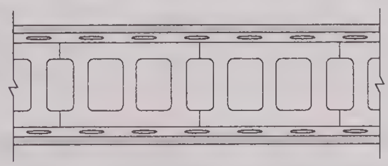
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
	B2f	B2 with • 190 mm concrete block • 12.7 mm Type X gypsum board[5]	2.5 h	2.5 h	49
	B2g	B2 with • 190 mm concrete block • 12.7 mm regular gypsum board[5]	2 h	2 h	48
	B3	• 140 mm or 190 mm concrete block • resilient metal channels on one side spaced at 406 mm or 610 mm o.c. • absorptive material filling resilient metal channel space[4] • 1 layer of gypsum board on each side			
	B3a	B3 with • 140 mm concrete block • 12.7 mm Type X gypsum board or 15.9 mm Type X gypsum board[5]	2 h	2 h	51
	B3b	B3 with • 140 mm concrete block • 12.7 mm regular gypsum board[5][7]	1.5 h	1.5 h	48
• Hollow Concrete Block (Normal Weight Aggregate)	B3c	B3 with • 190 mm concrete block • 15.9 mm Type X gypsum board[5]	3 h	3 h	54
	B3d	B3 with • 190 mm concrete block • 12.7 mm Type X gypsum board[5]	2.5 h	2.5 h	53
	B3e	B3 with • 190 mm concrete block • 12.7 mm regular gypsum board[5][7]	2 h	2 h	51
	B4	• 140 mm or 190 mm concrete block • resilient metal channels on each side spaced at 406 mm or 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side			
	B4a	B4 with • 140 mm concrete block • 12.7 mm Type X gypsum board or 15.9 mm Type X gypsum board[5]	2 h	2 h	47
	B4b	B4 with • 140 mm concrete block • 12.7 mm regular gypsum board[5][7]	1.5 h	1.5 h	42
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

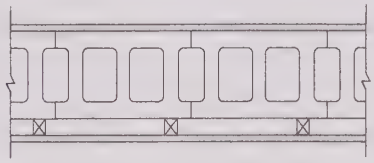
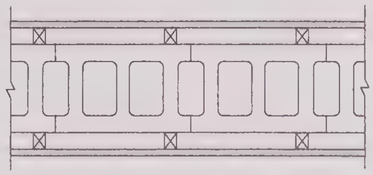
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
• Hollow Concrete Block (Normal Weight Aggregate)	B4c	B4 with • 190 mm concrete block • 15.9 mm Type X gypsum board(5)	3 h	3 h	50
	B4d	B2 with • 190 mm concrete block • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	49
	B4e	B2 with • 190 mm concrete block • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	45
	B5	• 190 mm concrete block • 38 mm x 38 mm horizontal or vertical wood strapping on one side spaced at 610 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side			
	B5a	B5 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	54
	B5b	B5 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	53
	B5c	B5 with • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	51
	B6	• 140 mm or 190 mm concrete block • 38 mm x 38 mm horizontal or vertical wood strapping on each side spaced at 610 mm o.c. • absorptive material filling strapping space on each side(4) • 1 layer of gypsum board on each side			
	B6a	B6 with • 140 mm concrete block • 12.7 mm Type X gypsum board or 15.9 mm Type X gypsum board(5)	2 h	2 h	57
	B6b	B6 with • 140 mm concrete block • 12.7 mm regular gypsum board(5)(7)	1.5 h	1.5 h	56
	B6c	B6 with • 190 mm concrete block • 15.9 mm Type X gypsum board(5)	3 h	3 h	60
	B6d	B6 with • 190 mm concrete block • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	59
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

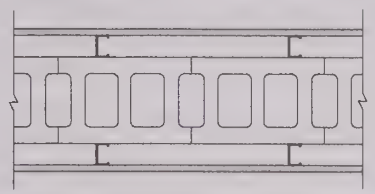
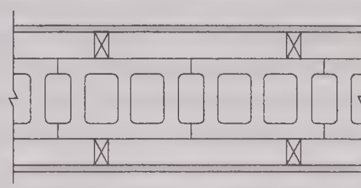
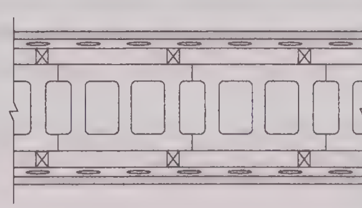
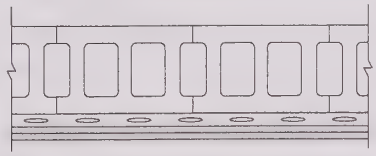
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3) (STC)
			Loadbearing	Non-Loadbearing	
	B6e	B4 with • 190 mm concrete block • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	57
	B7	• 190 mm concrete block • 65 mm steel studs each side spaced at 610 mm o.c. • absorptive material filling stud space on each side(4) • 1 layer of gypsum board on each side			
	B7a	B7 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	71
	B7b	B7 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	70
	B7c	B7 with • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	69
• Hollow Concrete Block (Normal Weight Aggregate)	**B8**	• 190 mm concrete block • 38 mm x 64 mm wood studs on each side spaced at 610 mm o.c. • absorptive material filling stud space on each side(4) • 1 layer of gypsum board on each side			
	B8a	B8 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	71
	B8b	B8 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	70
	B8c	B8 with • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	69
	B9	• 190 mm concrete block • 50 mm metal Z-bars on each side spaced at 610 mm o.c. (or 38 mm x 38 mm horizontal or vertical wood strapping plus resilient metal channels) • absorptive material filling Z-bar space on each side(4) • 1 layer of gypsum board on each side			
	B9a	B9 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	65
	B9b	B9 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	64
	B9c	B9 with • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	63
Column 1	2	3	4	5	6

Table 1 (Cont'd)
Fire and Sound Resistance of Walls

Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3] (STC)
			Loadbearing	Non-Loadbearing	
	B10	• 190 mm concrete block • resilient metal channels on one side spaced at 610 mm o.c. • absorptive material filling resilient metal channel space[4] • 2 layers of gypsum board on one side only			
	B10a	B10 with • 15.9 mm Type X gypsum board[5]	3 h	3 h	56
	B10b	B10 with • 12.7 mm Type X gypsum board[5]	2.5 h	2.5 h	55
	B10c	B10 with • 12.7 mm regular gypsum board[5][7]	2 h	2 h	54
Column 1	2	3	4	5	6

Notes to Table 1:

(1) Fire-resistance and STC ratings of wood frame construction were evaluated only for solid sawn 38 mm x 89 mm lumber. However, the fire-resistance ratings and STC ratings provided for 38 mm x 89 mm wood frame construction may be applied to 38 mm x 140 mm wood frame construction with solid sawn 38 mm x 140 mm lumber; in some cases the ratings may be conservative. Where 38 mm x 140 mm framing is used and absorptive material is called for, the absorptive material must be 140 mm thick. (See 1.2.1.(2) in MMAH Supplementary Standard SB-2 for the significance of fire-resistance ratings).

The STC ratings may also be applied to fingerjoined lumber. The fire-resistance ratings are applicable to wall assemblies using fingerjoined lumber that has been manufactured with a heat-resistant adhesive (HRA) in accordance with NLGA special product standard SPS-1, "Fingerjoined Structural Lumber", or SPS-3, "Fingerjoined 'Vertical Stud Use Only' Lumber". (See also Appendix Note A-9.23.10.4.(1) in Appendix A of the Building Code).

(2) Sound ratings listed are based on the most reliable laboratory test data available for specimens conforming to installation details required by CSA-A82.31, "Gypsum Board Application". Results of specific tests may differ slightly because of measurement precision and minor variations in construction details. These results should only be used where the actual construction details, including spacing or fasteners and supporting framing, correspond exactly to the details of the test specimens on which the ratings are based. Assemblies with sound transmission class ratings of 50 or more require acoustical sealant applied around electrical boxes and other openings, and at the junction of intersecting walls and floors, except intersection of walls constructed of concrete or solid brick.

(3) Sound ratings are only valid where there are no discernible cracks or voids in the visible surfaces. For concrete blocks, surfaces must be sealed by at least 2 coats of paint or other surface finish described in Section 9.29. of Division B of the Building Code to prevent sound leakage.

(4) Sound absorptive material includes fibre processed from rock, slag, glass or cellulose fibre. It must fill at least 90% of the cavity thickness for the wall to provide the listed STC value. The absorptive material should not overfill the cavity to the point of producing significant outward pressure on the finishes; such an assembly will not achieve the STC rating. Where the absorptive material used with steel stud assemblies is in batt form, "steel stud batts", which are wide enough to fill the cavity from the web of one stud to the web of the adjacent studs, must be used.

(5) The complete descriptions of indicated finishes are as follows:

- 12.7 mm regular gypsum board — 12.7 mm regular gypsum board conforming to Article 9.29.5.2. of Division B of the Building Code.
- 12.7 mm Type X gypsum board — 12.7 mm special fire-resistant Type X gypsum board conforming to Article 9.29.5.2. of Division B of the Building Code.
- 15.9 mm Type X gypsum board — 15.9 mm special fire-resistant Type X gypsum board conforming to Article 9.29.5.2. of Division B of the Building Code.
- Except for exterior walls (see Note 9), the outer layer of finish on both sides of the wall must have its joints taped and finished.
- Fastener types and spacing must conform to CSA-A82.31-M, “Gypsum Board Application”.

(6) Absorptive material required for the higher fire-resistance rating is mineral fibre processed from rock or slag with a mass of at least 4.8 kg/m² for 150 mm thickness, 2.8 kg/m² for 89 mm thickness and 2.0 kg/m² for 65 mm thickness and completely filling the wall cavity. For assemblies with double wood studs on separate plates, absorptive material is required in the stud cavities on both sides.

(7) Regular gypsum board used in single layer assemblies must be installed so all edges are supported.

(8) Where bracing material, such as diagonal lumber or plywood, OSB, gypsum board or fibreboard sheathing is installed on the inner face of one row of studs in double stud assemblies, the STC rating will be reduced by 3 for any assemblies containing absorptive material in both rows of studs or in the row of studs opposite to that which the bracing material is attached. Attaching such layers on both inner faces of the studs may drastically reduce the STC value but enough data to permit assignment of STC ratings for this situation is not available. The fire-resistance rating is not affected by the inclusion of such bracing.

(9) For exterior walls, the finish joints must be taped and finished for the outer layer of the interior side only. The gypsum board on the exterior side may be replaced with gypsum sheathing of the same thickness and type (regular or Type X).

SB-7 Guards for Housing and Small Buildings

Section 1 General

1.1. Introduction

1.1.1. Scope (See Appendix A.)

(1) This Supplementary Standard includes details for the construction of wood guards.

(2) Guards located on the exterior of a building, where they may be subject to deterioration, shall be constructed in accordance with Section 2 of this Supplementary Standard. (See Appendix A.)

(3) Guards located inside a building shall be constructed in conformance with Section 2 or Section 3 of this Supplementary Standard.

1.2. Design of Guards

1.2.1. Cantilever Action (See Appendix A.)

(1) The construction details for guards in this Supplementary Standard are based on the assumption that the guard acts as a cantilever in resisting lateral loads.

1.2.2. Classification (See Appendix A.)

(1) The structural systems of guards described in this Supplementary Standard are grouped into the following classifications:
(a) Post and Rail Systems, and
(b) Cantilevered Picket Systems.

Section 2 Exterior Guards

2.1. Materials

2.1.1. Lumber Grades (See Appendix A)

(1) The minimum grade of softwood dimension lumber for posts, rails and joists shall be Northern Species, No. 2.

(2) The minimum grade of softwood dimension lumber for pickets shall be Northern Species, No. 2 Picket grade.

(3) Wood for pickets shall be free of loose knots.

2.1.2. Lumber Dimensions

(1) Except as permitted in Sentence (2), the minimum sizes of loadbearing elements of wood guards shall conform to Table 2.1.2.

Table 2.1.2
Minimum Size of Loadbearing Elements

Guard Element	Minimum Size, mm (in)
Post	89 x 89 (4" x 4" nominal)
Top Rail	38 x 89 (2" x 4" nominal)
Bottom Rail	38 x 89 (2" x 4" nominal)
Picket / Baluster	32 x 32 ($1^{9}/_{32}$" x $1^{9}/_{32}$")
Column 1	2

(2) Where a bottom rail is bevelled, the minimum sizes shown in Table 2.1.2. may be reduced to allow for a bevel, as detailed in Figure 2.1.2.

Figure 2.1.2
Bevel Detail

2.1.3. Floor Construction (See Appendix A.)

(1) The minimum dimensions of wood floor joists and wood decking shall conform to Table 2.1.3.

(2) Except as provided in Details EA-1 to ED-5, wood decking shall be fastened to each floor joist with nailing conforming to Table 2.1.3.

Table 2.1.3
Minimum Size of Floor Elements

Floor Element	Minimum size, mm (in)
Dimension Lumber Decking	25 x 140 ($^{5}/_{4}$" x 6" nominal), when each plank is fastened with 2 - 63 mm (2½") nails
	38 x 89 (2" x 4" nominal), when each plank is fastened with 2 - 76 mm (3") nails
Dimension Lumber Joists	38 x 184 (2" x 8" nominal)
Column 1	2

2.1.4. Connectors (See Appendix A.)

(1) Nails, screws, lag bolts and machine bolts shall not cause splitting of wood elements.

(2) Fasteners shall be resistant to corrosion.

(3) All nails shall be common spiral.

(See also A-2.1.4. in Appendix A for glued joints.)

2.1.5. Decay-Resistant Lumber (See Appendix A.)

(1) Lumber for guard systems and floor systems shall be
(a) a species resistant to decay,
(b) preservative treated to prevent decay, or
(c) pressure-treated.

(2) All cut ends of preservative treated lumber shall be treated to prevent decay.

2.2. Structural Details

2.2.1. Post and Rail System

(1) An exterior guard constructed as a Post and Rail System shall conform to the applicable connection details listed in Table 2.2.1.

2.2.2. Cantilevered Picket System

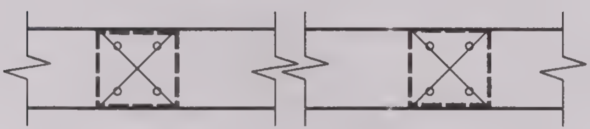
(1) An exterior guard constructed as a Cantilevered Picket System shall conform to the applicable connection details listed in Table 2.2.2.

Table 2.2.1
Exterior Post and Rail System Connection Details

Connection Detail	Detail Number	Description
Top Rail to Post and / or Bottom Rail to Post	EA-1	Top rail nailed to post
	EA-2	Top/bottom rail skew nailed to post with 76 mm (3") nails
	EA-3	Top/bottom rail skew nailed to post with 63 mm ($2^1/_2$") nails
	EA-4	Top/bottom rail face nailed or screwed to post
	EA-5	Top/bottom rail fastened to post with framing anchors
Post to Floor	EB-1	Post nailed to rim joist
	EB-2	Post screwed to rim joist
	EB-3	Post bolted to floor joist with 8 mm ($^5/_{16}$") machine bolts
	EB-4	Post bolted to floor joist with 9.5 mm ($^3/_8$") machine bolts
	EB-5	Post bolted to 2 floor joists
	EB-6	Post fastened to floor, where guard is parallel to floor joists
Infill Picket	EC-1	Picket nailed to endcap; endcap screwed to rail
	EC-2	Picket nailed to rail
	EC-3	Picket screwed to rail
	EC-4	Picket screwed to top rail and rim joist
Column 1	2	3

Table 2.2.2
Exterior Cantilevered Picket System Connection Details

Connection Detail	Detail Number	Description
Cantilevered Picket (Douglas Fir-Larch, Spruce-Pine-Fir, Hem-Fir Species)	ED-1	Picket screwed to rim joist
	ED-2	Picket screwed to rim joist, where guard is parallel to floor joists
Cantilevered Picket (Northern Species)	ED-3	Picket screwed to rim joist and deck
	ED-4	Picket screwed to rim joist and deck, where guard is parallel to floor joists
Cantilevered Picket (Douglas Fir-Larch, Spruce-Pine-Fir, Hem-Fir Species, Northern Species)	ED-5	Corner
Column 1	2	3



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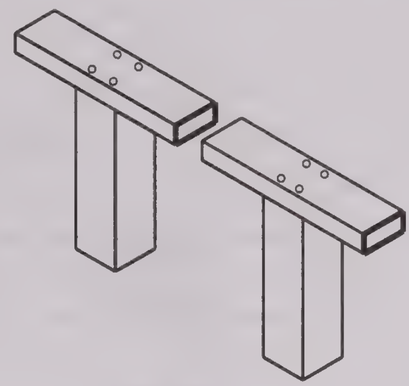

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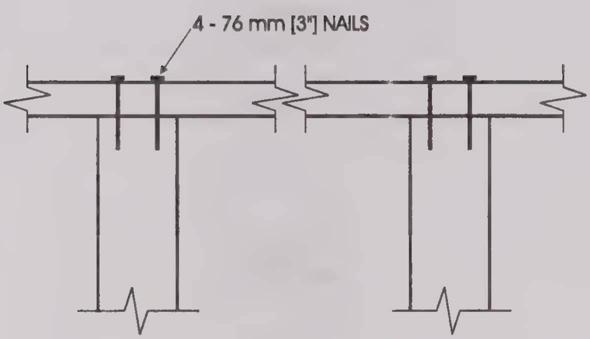
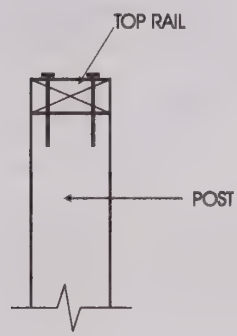


FRONT ELEVATION



SIDE ELEVATION

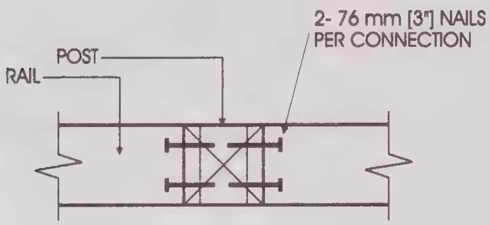
Detail EA-1

Exterior Connection: Top Rail Nailed to Post

Notes:

1. The top rail must be continuous. Use Detail EA-5 at the end spans, where continuity ends.

MAXIMUM SPAN OF RAIL BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	1.52 (5'-0")
Northern Species	1.52 (5'-0")
Column 1	2



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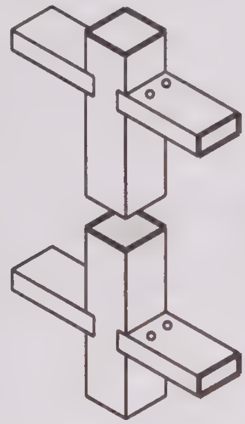

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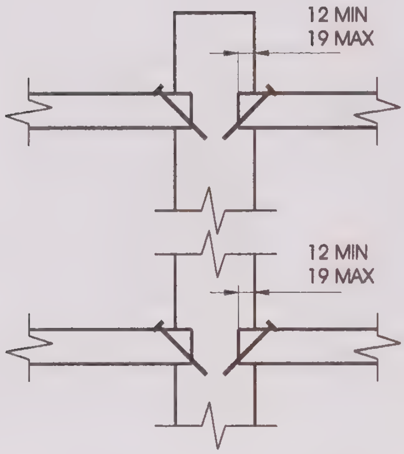

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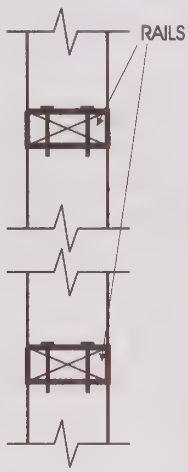
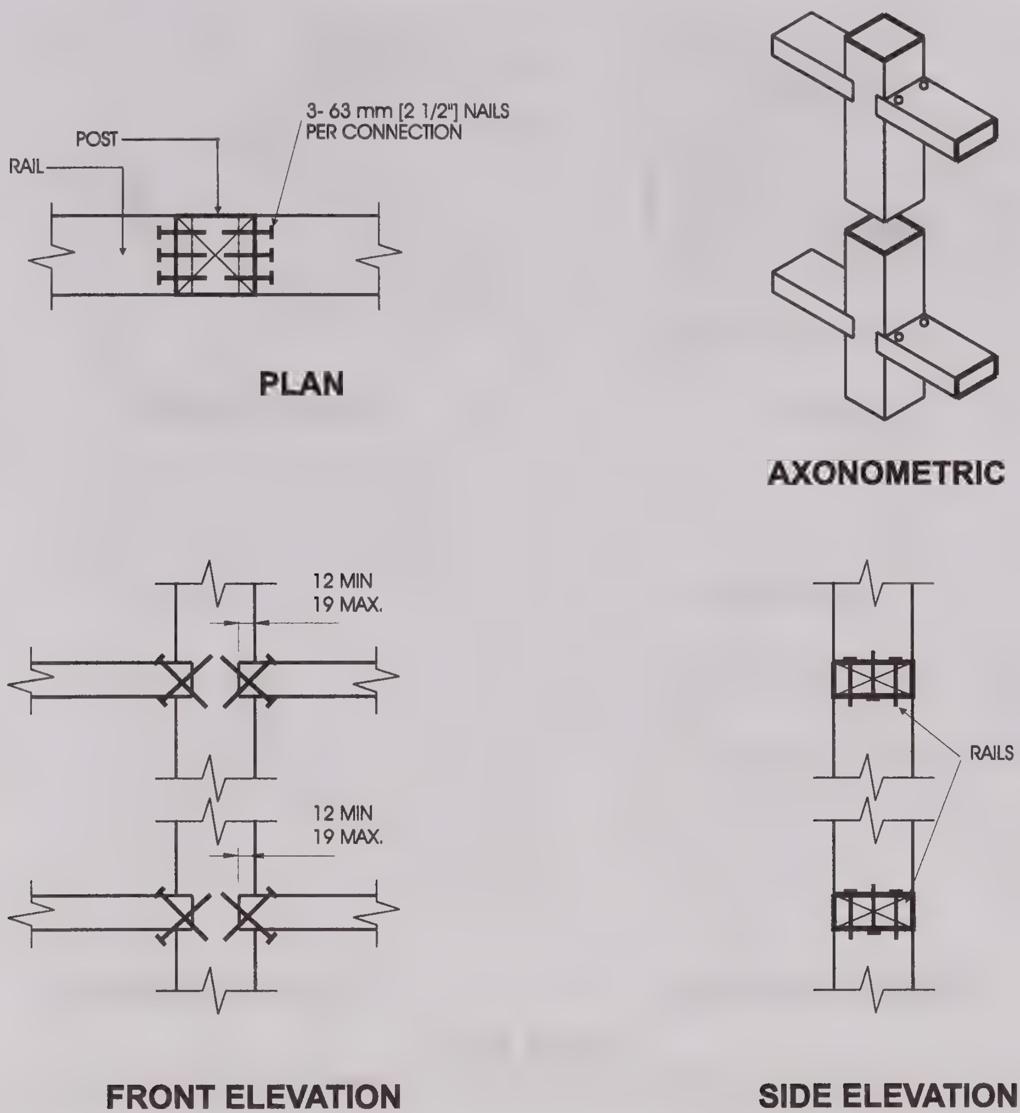


SIDE ELEVATION

Detail EA-2
Exterior Connection: Top/Bottom Rail Skew Nailed to Post - 76 mm (3") Nails

Notes:
1. The maximum span is more often governed by post spacing.
2. Provide support to bottom rail at intervals not more than 2.0 m (6'-7").
3. The bottom rail may be bevelled as detailed in Figure 2.1.2.
4. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPAN OF RAIL BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	2.72 (8'-11")
Northern Species	2.18 (7'-2")
Column 1	2



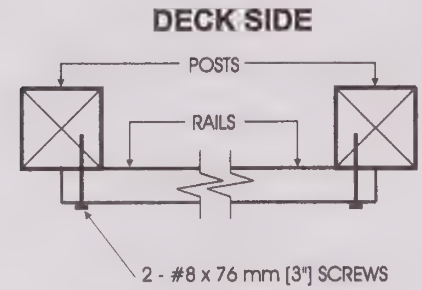
Detail EA-3

Exterior Connection: Top/Bottom Rail Skew Nailed to Post - 63 mm (2½") Nails

Notes:

1. Provide support to bottom rail at intervals not more than 2.0 m (6'-7").
2. The bottom rail may be bevelled as detailed in Figure 2.1.2.
3. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPAN OF RAIL BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	2.72 (8'-11")
Northern Species	2.18 (7'-2")
Column 1	2



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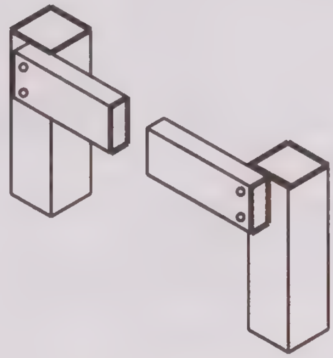

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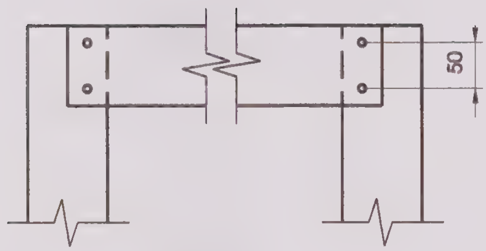
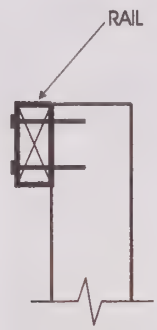


FRONT ELEVATION



SIDE ELEVATION

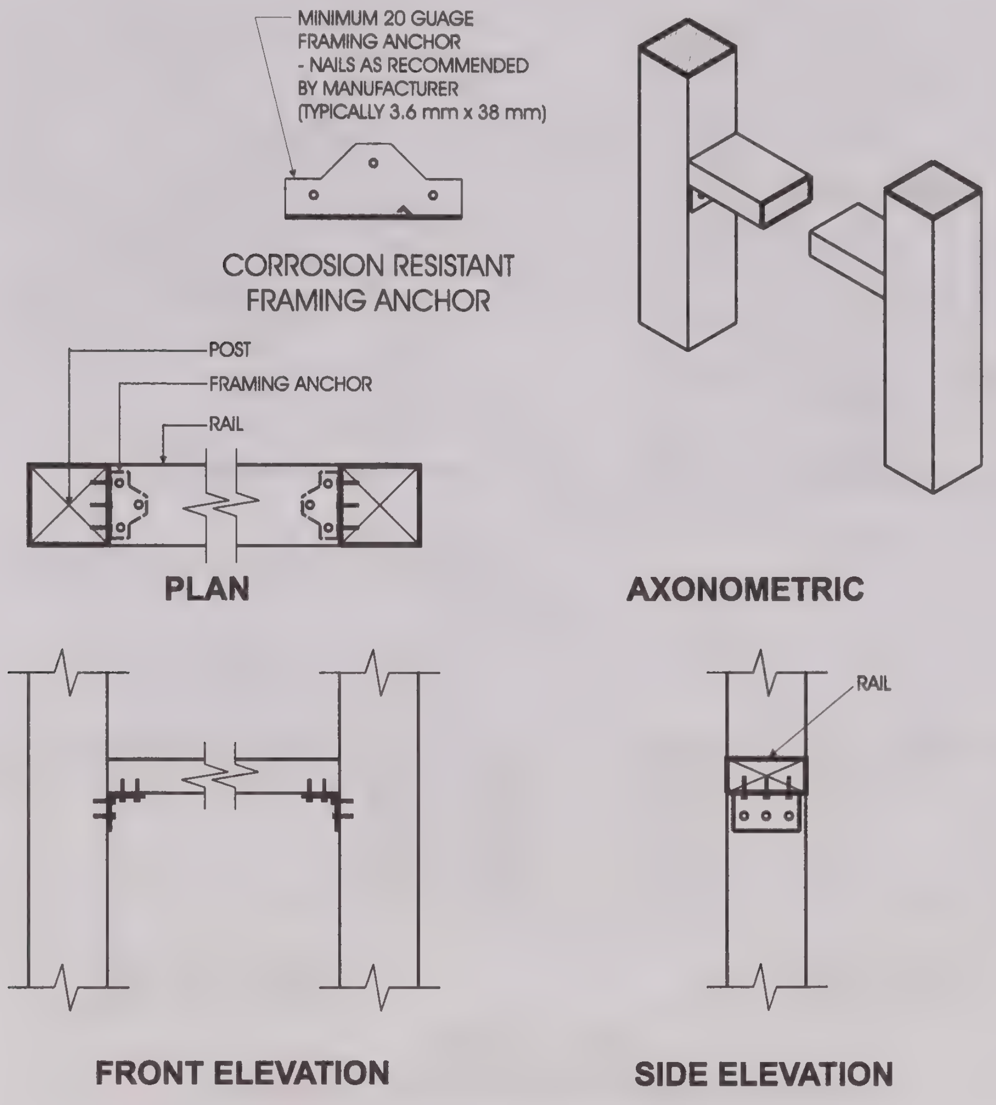
Detail EA-4

Exterior Connection: Top/Bottom Rail Face Nailed or Screwed to Post

Notes:

1. If the rails are located on the deck side of the posts, 76 mm (3") nails may be used in place of the screws.
2. Where the top rail is continuous, the top rail may be fastened to each post with 3 - #8 x 76 mm (3") screws.
3. Dimensions shown are in mm unless otherwise specified.

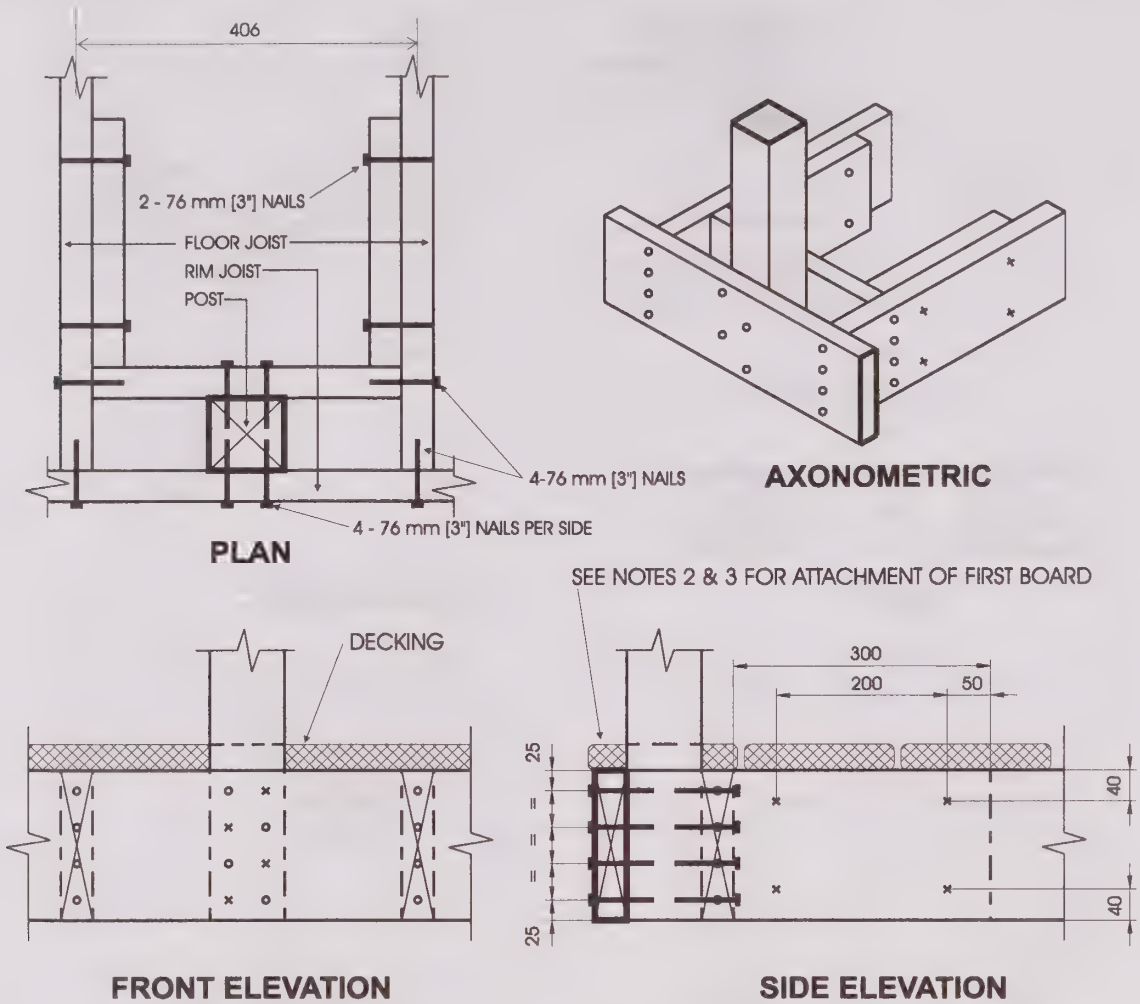
MAXIMUM SPAN OF RAIL BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	1.77 (5'-10")
Northern Species	1.41 (4'-8")
Column 1	2



Detail EA-5
Exterior Connection: Top/Bottom Rail Fastened to Post with Framing Anchors

Notes:
1. Provide support to bottom rail at intervals not more than 2.0 m (6'-7").
2. The bottom rail may be bevelled as detailed in Figure 2.1.2.
3. Dimensions shown are in mm unless otherwise specified.

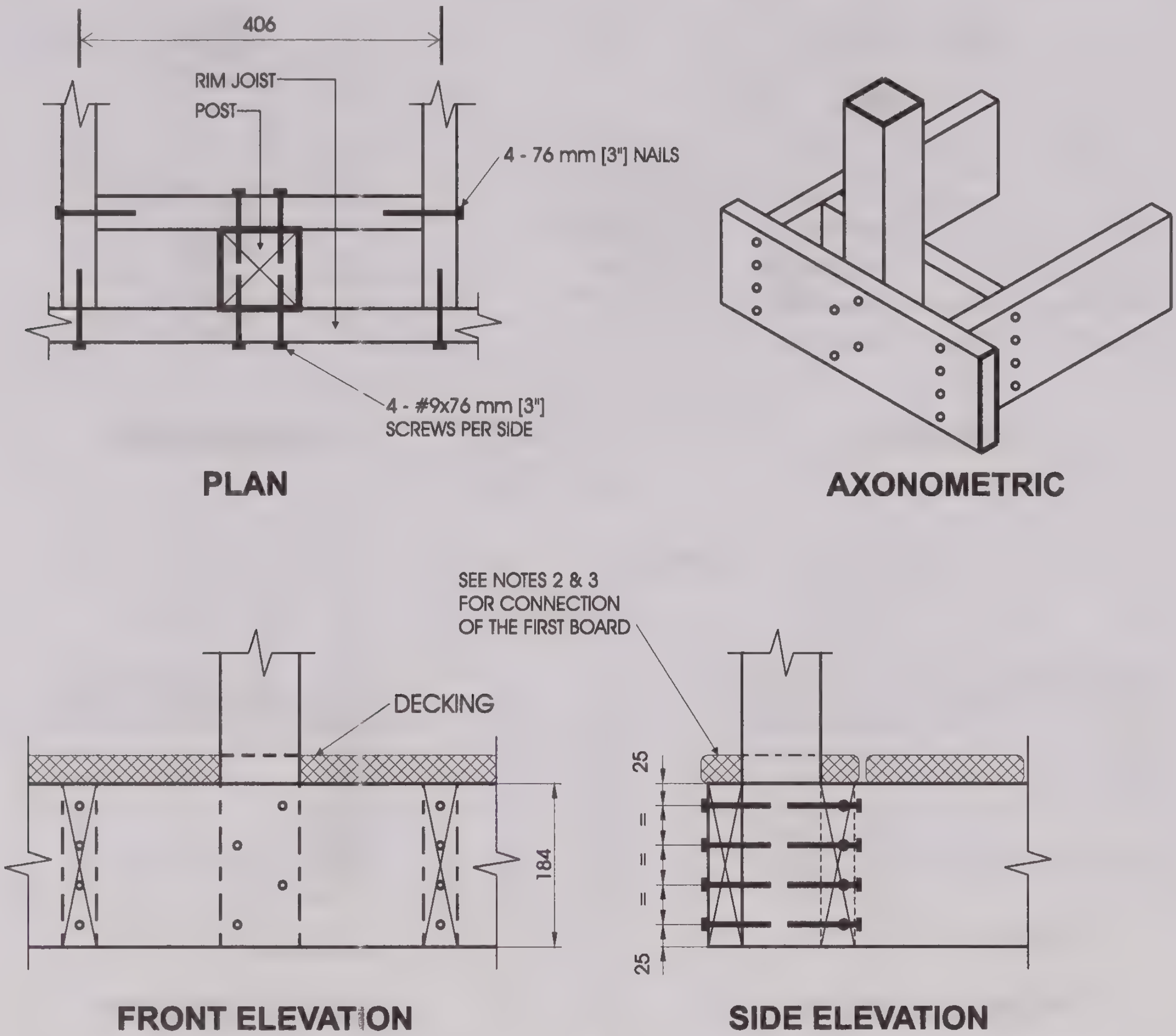
MAXIMUM SPAN OF RAIL BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	2.72 (8'-11")
Northern Species	2.18 (7'-2")
Column 1	2



Detail EB-1
Exterior Connection: Post Nailed to Rim Joist

Notes:
1. Decking is omitted from the plan view and the axonometric view for clarity.
2. Fasten 25 mm x 140 mm (5/4" x 6" nominal) outer deck board to rim joist with 63 mm (21/2") nails at 300 mm (12").
3. Fasten 25 mm x 140 mm (5/4" x 6" nominal) outer deck board to floor joist with 1 - 63 mm (21/2") nail at each joist.
4. The post may be positioned anywhere between the joists.
5. Dimensions shown are in mm unless otherwise specified.

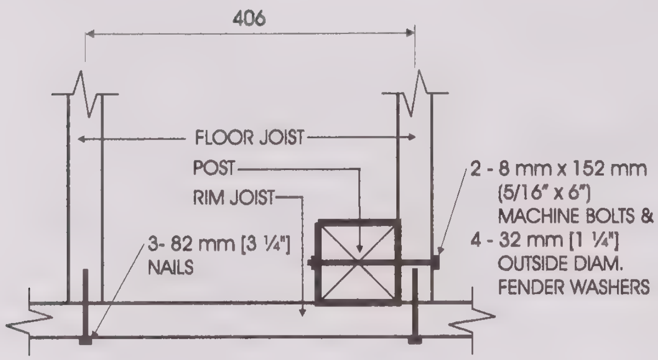
MAXIMUM SPAN OF RAIL BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	1.22 (4'-0")
Northern Species	1.20 (3'-11")
Column 1	2



Detail EB-2
Exterior Connection: Post Screwed to Rim Joist

Notes:
1. Decking is omitted from the plan view and the axonometric view for clarity.
2. Fasten 25 mm x 140 mm (5/4" x 6" nominal) outer deck board to rim joist with 63 mm (21/2") nails at 300 mm (12").
3. Fasten 25 mm x 140 mm (5/4" x 6" nominal) outer deck board to floor joist with 1 - 63 mm (21/2") nail at each joist.
4. The post may be positioned anywhere between the joists.
5. #9 screws may be replaced by #8 screws if the maximum spacing between posts is not more than 1.20 m (3'-11").
6. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPAN OF RAIL BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	1.56 (5'-1")
Northern Species	1.20 (3'-11")
Column 1	2



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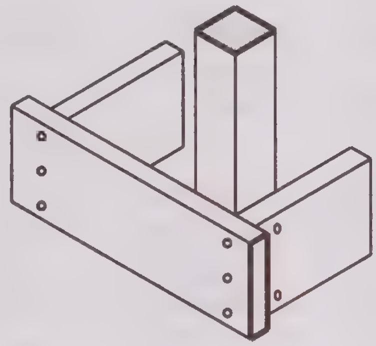

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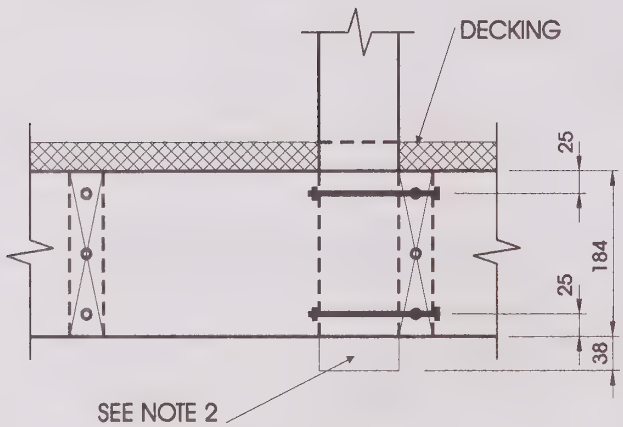
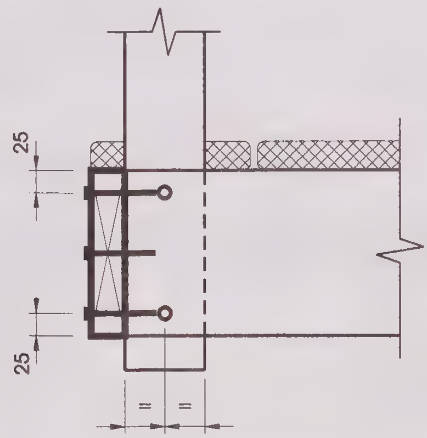


FRONT ELEVATION

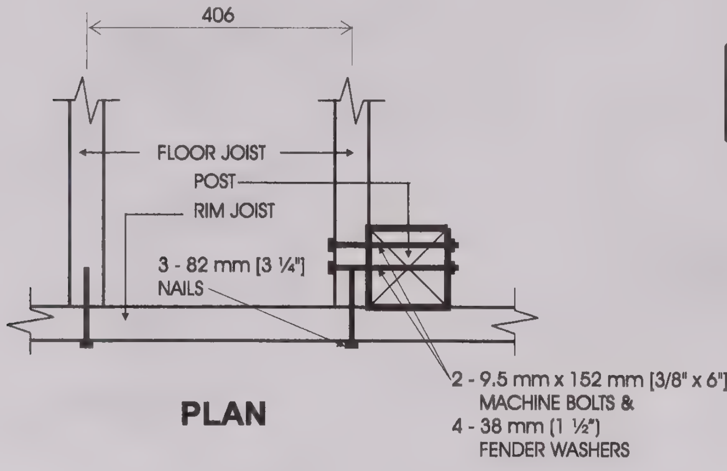


SIDE ELEVATION

Detail EB-3
Exterior Connection: Post Bolted to Floor Joist - 8 mm (5/16") Bolts

Notes:
1. Decking is omitted from the plan view and the axonometric view for clarity.
2. 38 mm (11/2") post projection is not required where the maximum spacing between posts does not exceed 1.20 m (3'-11").
3. Joists may be spaced at 610 mm (24") o.c. or 406 mm (16") o.c.
4. Where floor joists are spaced at 610 mm (24") o.c., decking shall have a minimum thickness of 38 mm (11/2") and shall be fastened to the floor with 2 - 76 mm (3") nails.
5. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPACING BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	1.29 (4'-3")
Northern Species	1.20 (3'-11")
Column 1	2



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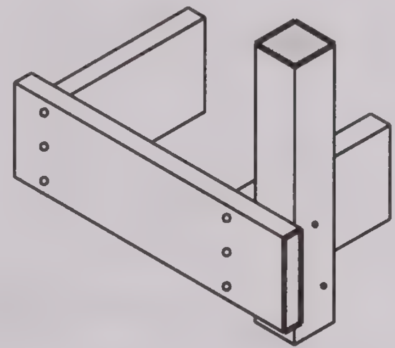

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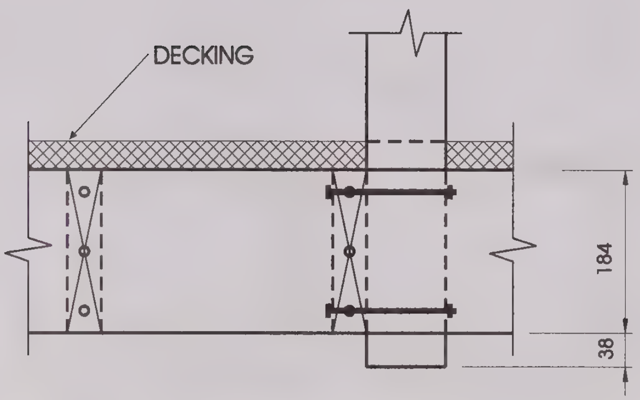
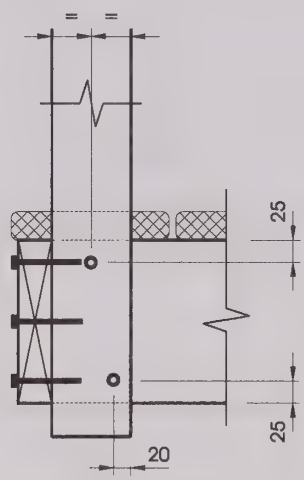


FRONT ELEVATION



SIDE ELEVATION

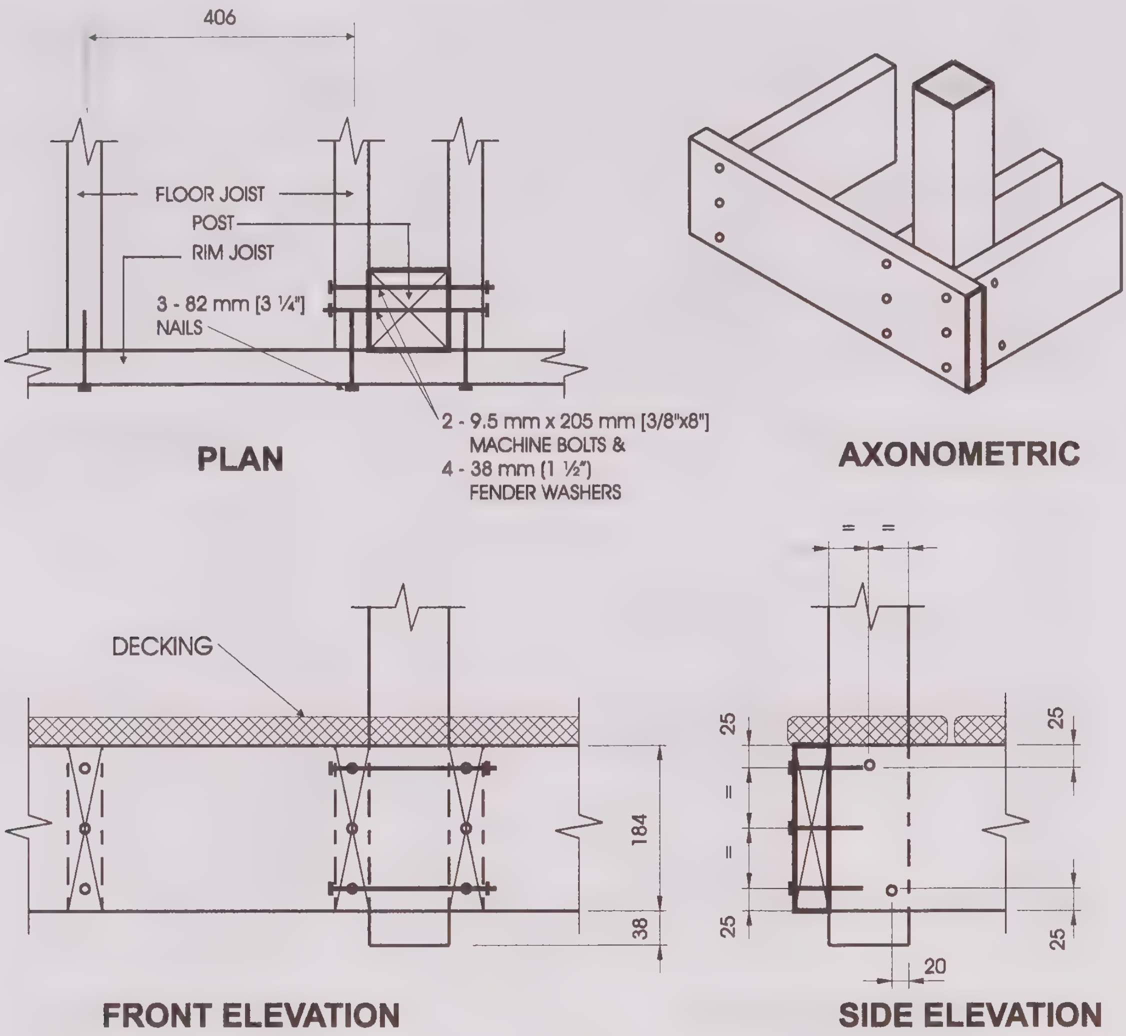
Detail EB-4

Exterior Connection: Post Bolted to Floor Joist - 9.5 mm (3/8") Bolts

Notes:

1. Decking is omitted from the plan view and the axonometric view for clarity.
2. 38 mm (11/2") post projection is not required where the maximum spacing between posts does not exceed 1.20 m (3'-11").
3. Joists may be spaced at 610 mm (24") o.c. or 406 mm (16") o.c.
4. Where floor joists are spaced at 610 mm (24") o.c., decking shall have a minimum thickness of 38 mm (11/2") and shall be fastened to the floor with 2 - 76 mm (3") nails.
5. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPACING BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	1.49 (4'-11")
Northern Species	1.20 (3'-11")
Column 1	2

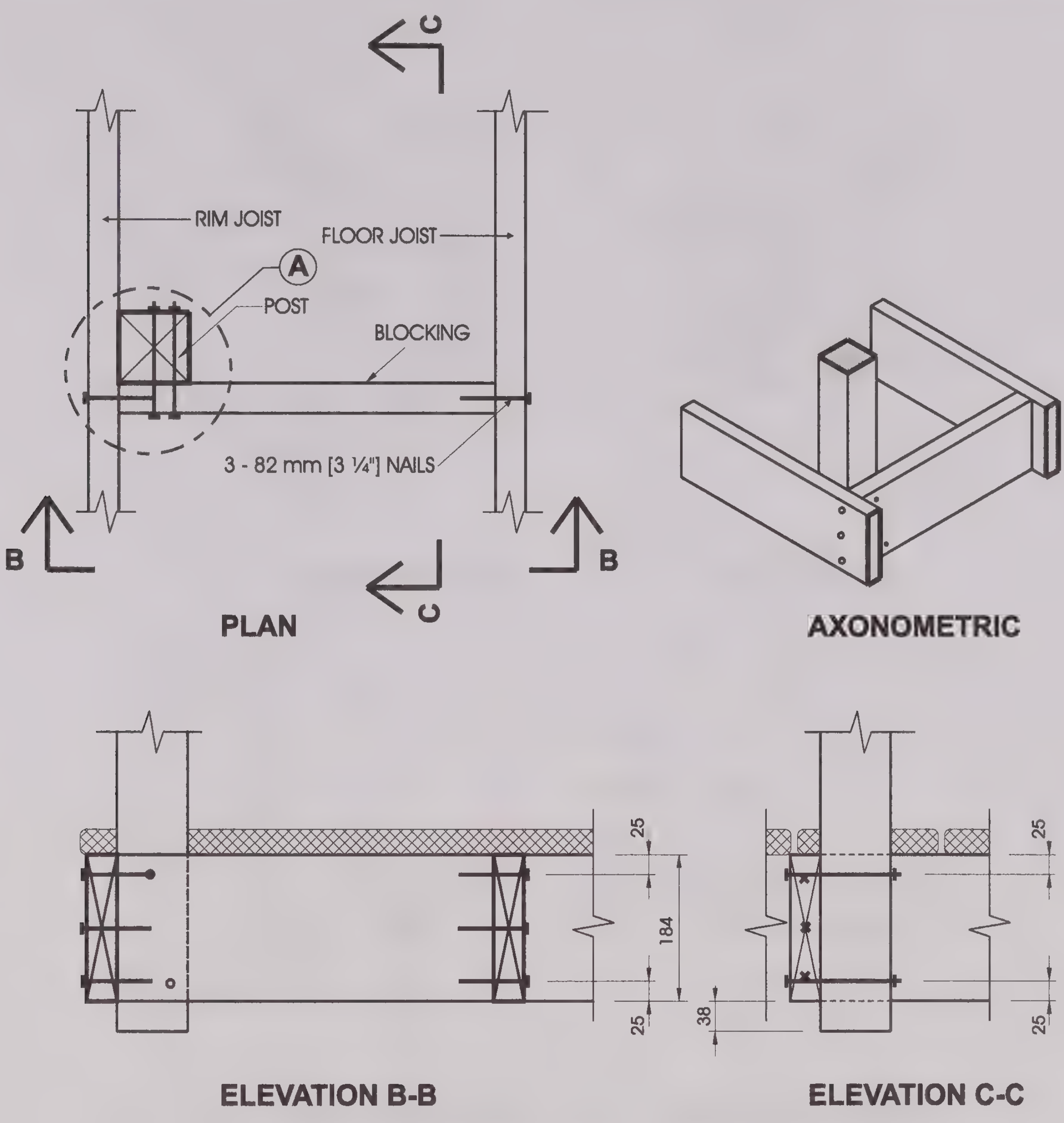


Detail EB-5
Exterior Connection: Post Bolted to 2 Floor Joists

Notes:

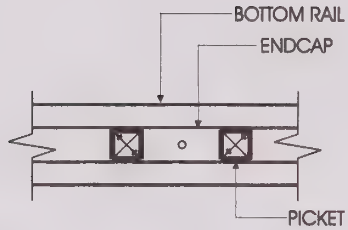
1. Decking is omitted from the plan view and the axonometric view for clarity.
2. 38 mm (11/2") post projection is not required where the maximum spacing between posts does not exceed 1.20 m (3'-11").
3. Joists may be spaced at 610 mm (24") o.c. or 406 mm (16") o.c..
4. Where floor joists are spaced at 610 mm (24") o.c. decking shall have a minimum thickness of 38 mm (11/2") and shall be fastened to the floor with 2 - 76 mm (3") nails.
5. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPACING BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir	2.14 (7'-0")
Northern Species	1.20 (3'-11")
Column 1	2

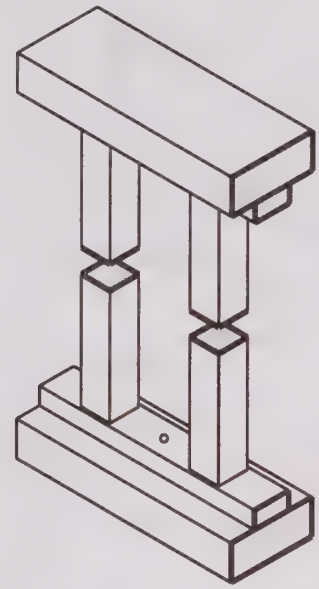


Detail EB-6
Exterior Connection: Post Fastened to Floor, Guard Parallel to Floor Joists

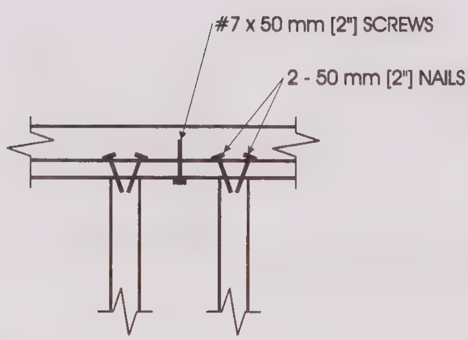
Notes:
1. Use any of the connection details shown on Details EB-1 to EB-5 at location "A". Connection Detail EB-4 is shown in this detail, as an example.
2. Maximum spacing between posts is determined from connection detail used at location "A".
3. Decking is omitted from the plan view and the axonometric view for clarity.
4. Blocking shall be not less than 38 mm x 184 mm (2" x 8" nominal).
5. Dimensions shown are in mm unless otherwise specified.



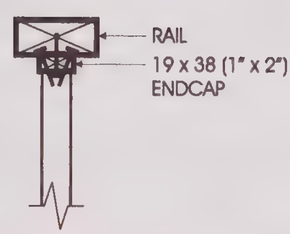
PLAN
BOTTOM RAIL



AXONOMETRIC



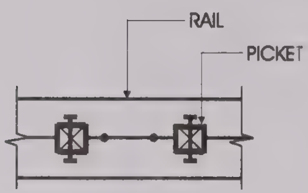
FRONT ELEVATION



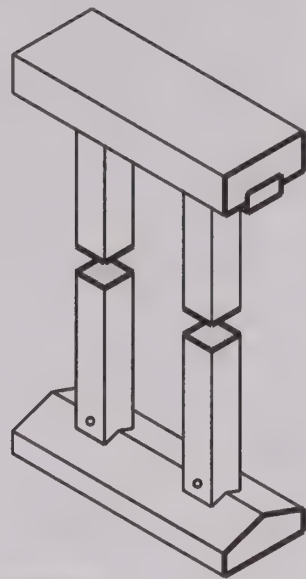
SIDE ELEVATION

Detail EC-1
Exterior Connection: Infill Picket Nailed to Endcap - Endcap Screwed to Rail

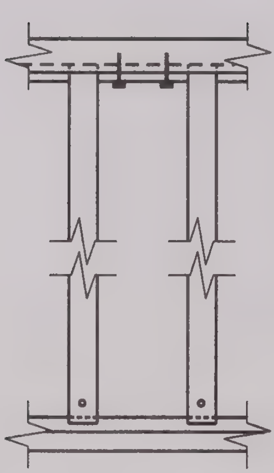
Notes:
1. Fasten each end of each picket to endcaps with 2 - 50 mm (2") nails.
2. Fasten endcaps to rails with #7 x 50 mm (2") screws at 300 mm (12") o.c.
3. See Table 2.1.2. for minimum sizes of pickets.



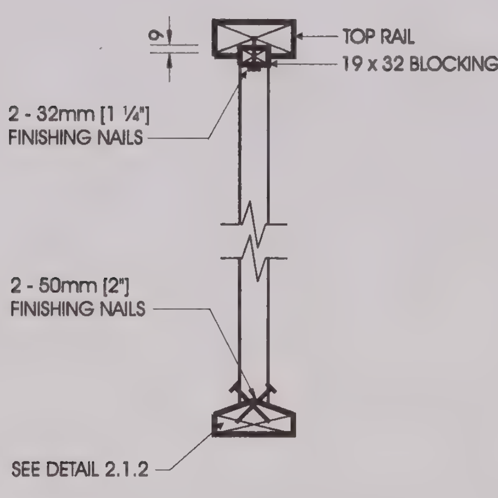
**PLAN
BOTTOM RAIL**



AXONOMETRIC



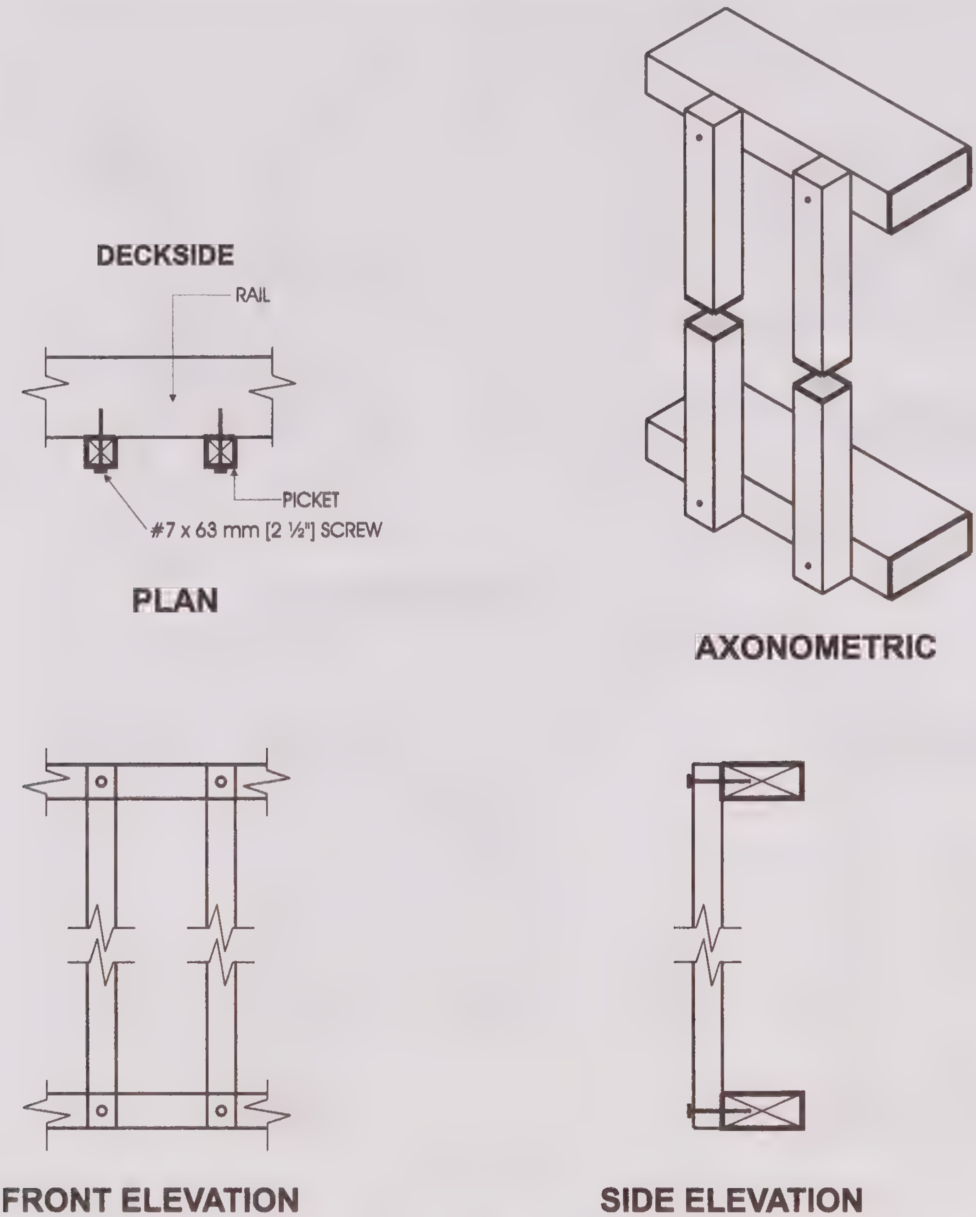
FRONT ELEVATION



SIDE ELEVATION

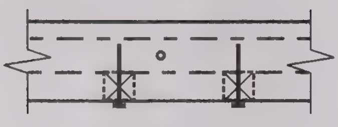
Detail EC-2
Exterior Connection: Infill Picket Nailed to Rail

Notes:
1. See Table 2.1.2. for minimum sizes of pickets.
2. Dimensions shown are in mm unless otherwise specified.

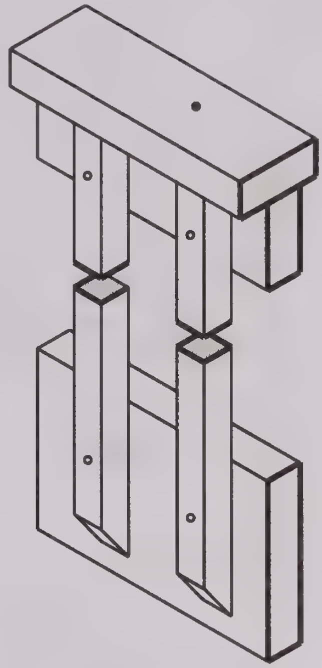


Detail EC-3
Exterior Connection: Infill Picket Screwed to Rail

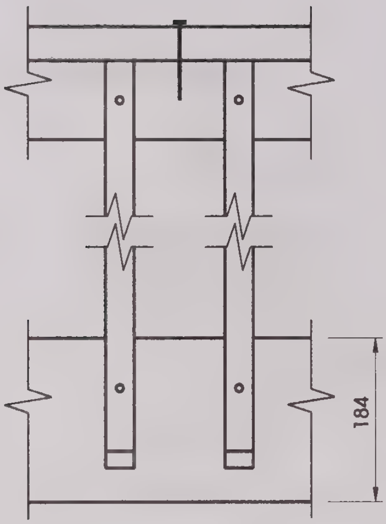
DECKSIDE

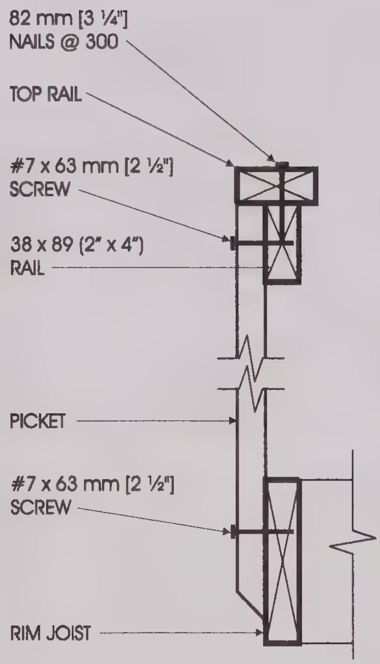


PLAN



AXONOMETRIC



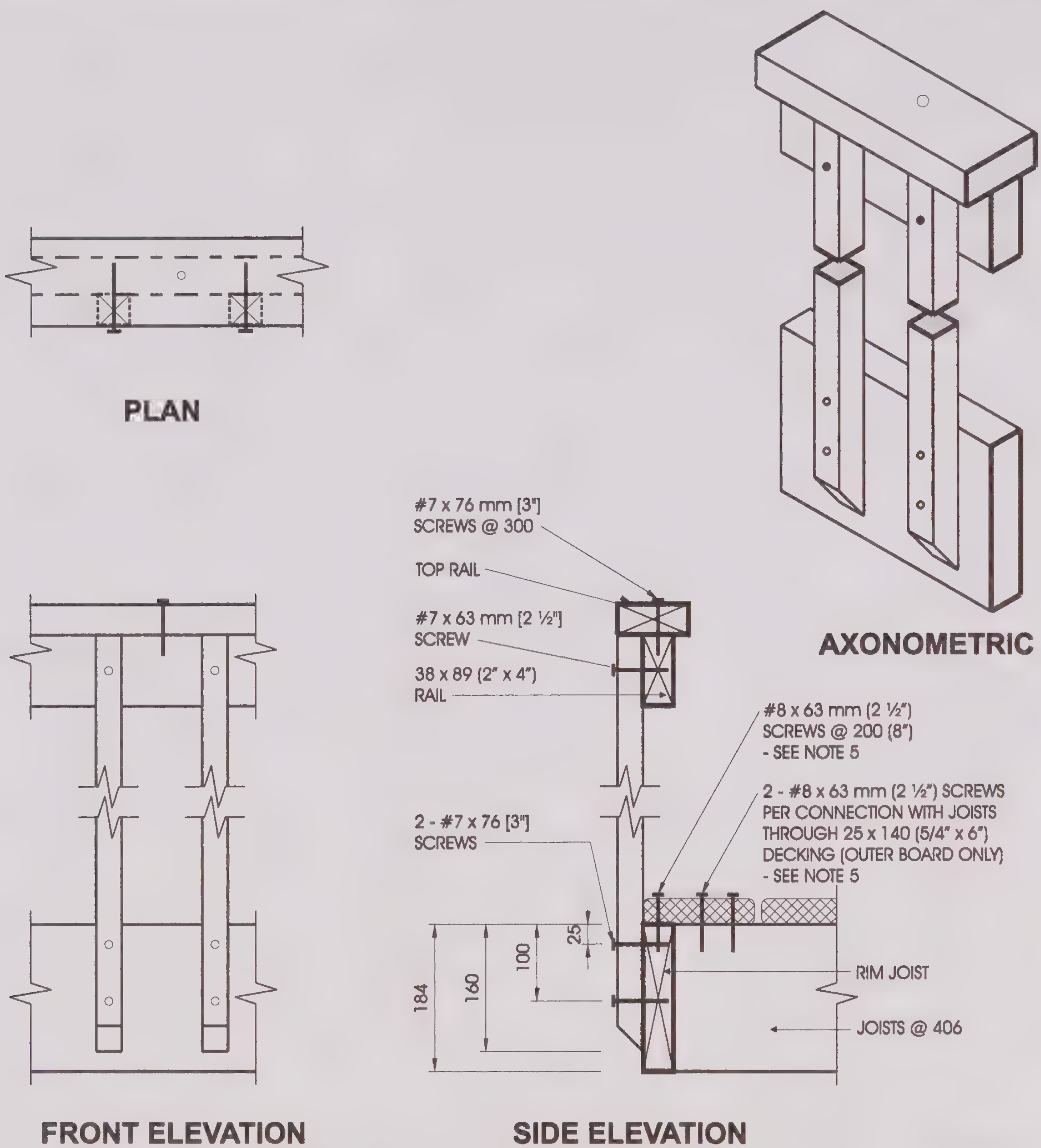


FRONT ELEVATION **SIDE ELEVATION**

Detail EC-4

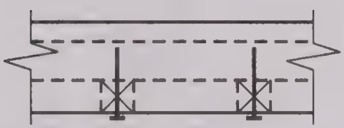
Exterior Connection: Infill Picket Screwed to Top Rail and Rim Joist

Note:
1. Dimensions shown are in mm unless otherwise specified.

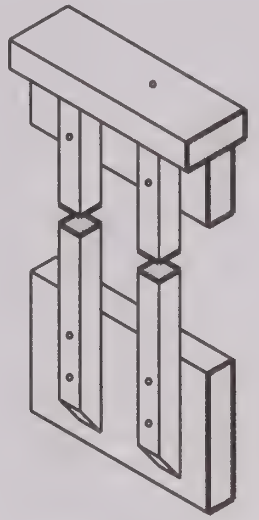


Detail ED-1
Exterior Connection: Cantilevered Picket Screwed to Rim Joist

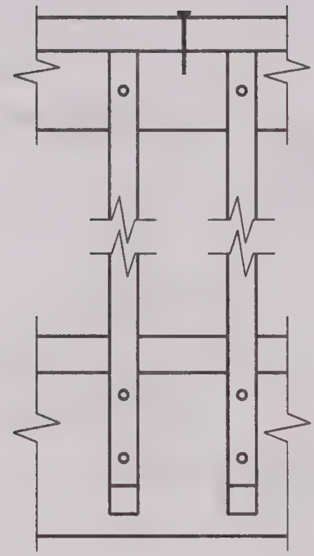
Notes:
1. Provide a suitable post, return, or solid support at each end of the guard.
2. Wood for cantilevered pickets shall be Douglas Fir-Larch, Spruce-Pine-Fir, or Hem-Fir Species.
3. Fasten rim joist to each floor joist with 3 - 82 mm (31/4") nails.
4. Dimensions shown are in mm unless otherwise specified.
5. The outer deck board shall not be less than 140 mm (6" nominal) wide. Where 38 mm (2" nominal) thick boards are used, the length of the wood screws shall be not less than 76 mm (3").

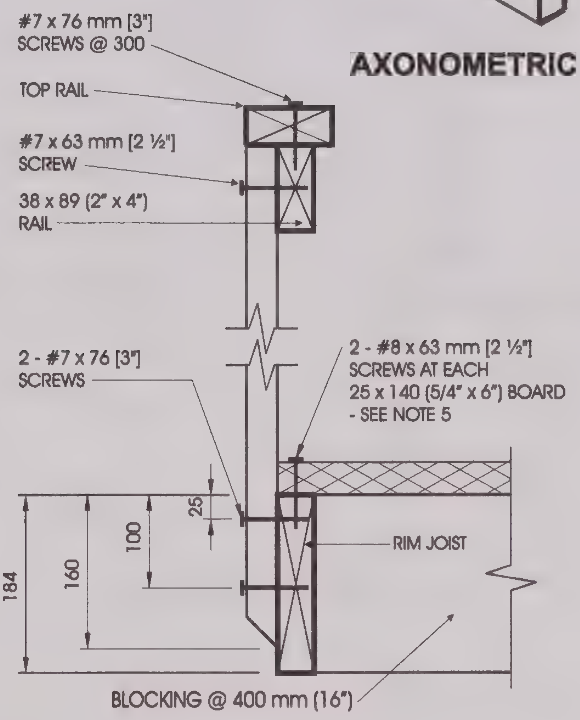


PLAN



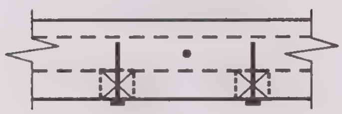
AXONOMETRIC



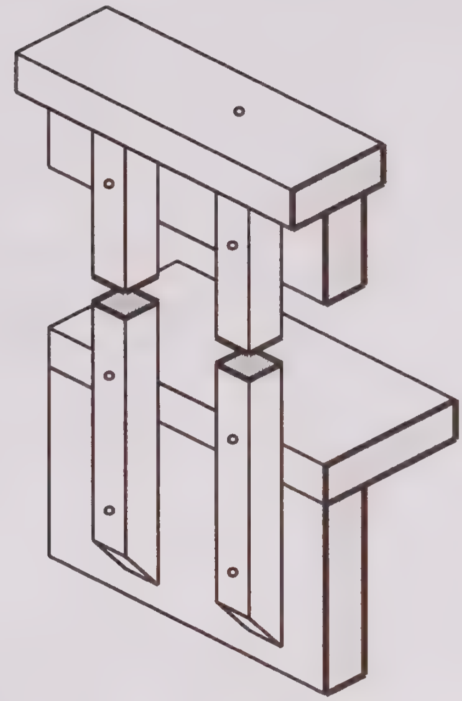


Detail ED-2
Exterior Connection: Cantilevered Picket Screwed to Rim Joist, Guard Parallel to Floor Joists

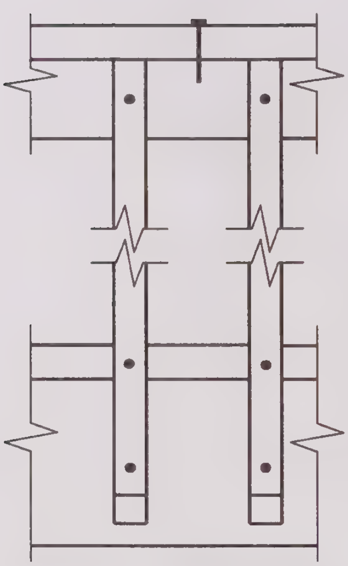
Notes:
1. Provide a suitable post, return, or solid support at each end of the guard.
2. Wood for cantilevered pickets shall be Douglas Fir-Larch, Spruce-Pine-Fir, or Hem-Fir Species.
3. Fasten rim joist to blocking with 3 - 82 mm (31/4") nails.
4. Dimensions shown are in mm unless otherwise specified.
5. Where 38 mm (2" nominal) thick boards are used, the length of the wood screws shall be not less than 76 mm (3").



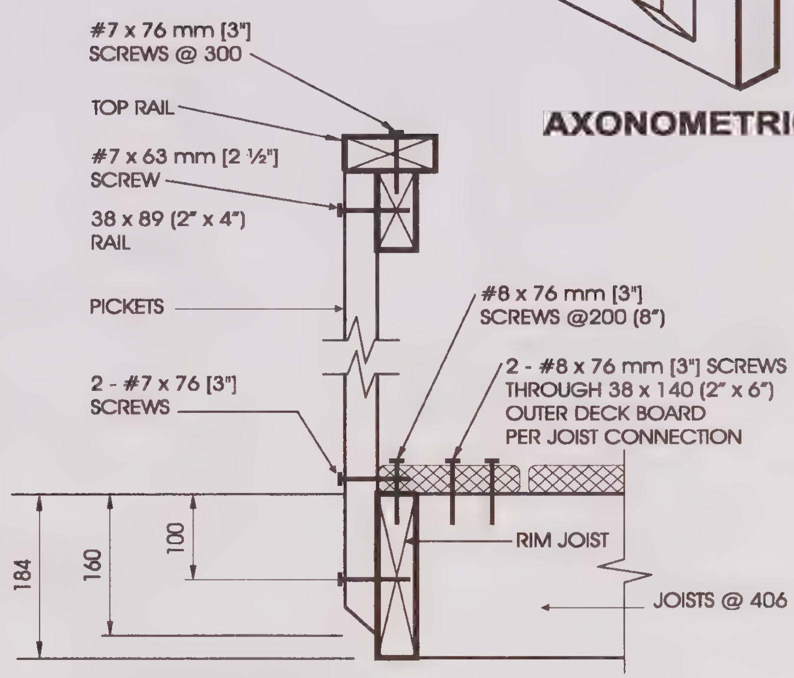
PLAN



AXONOMETRIC



FRONT ELEVATION

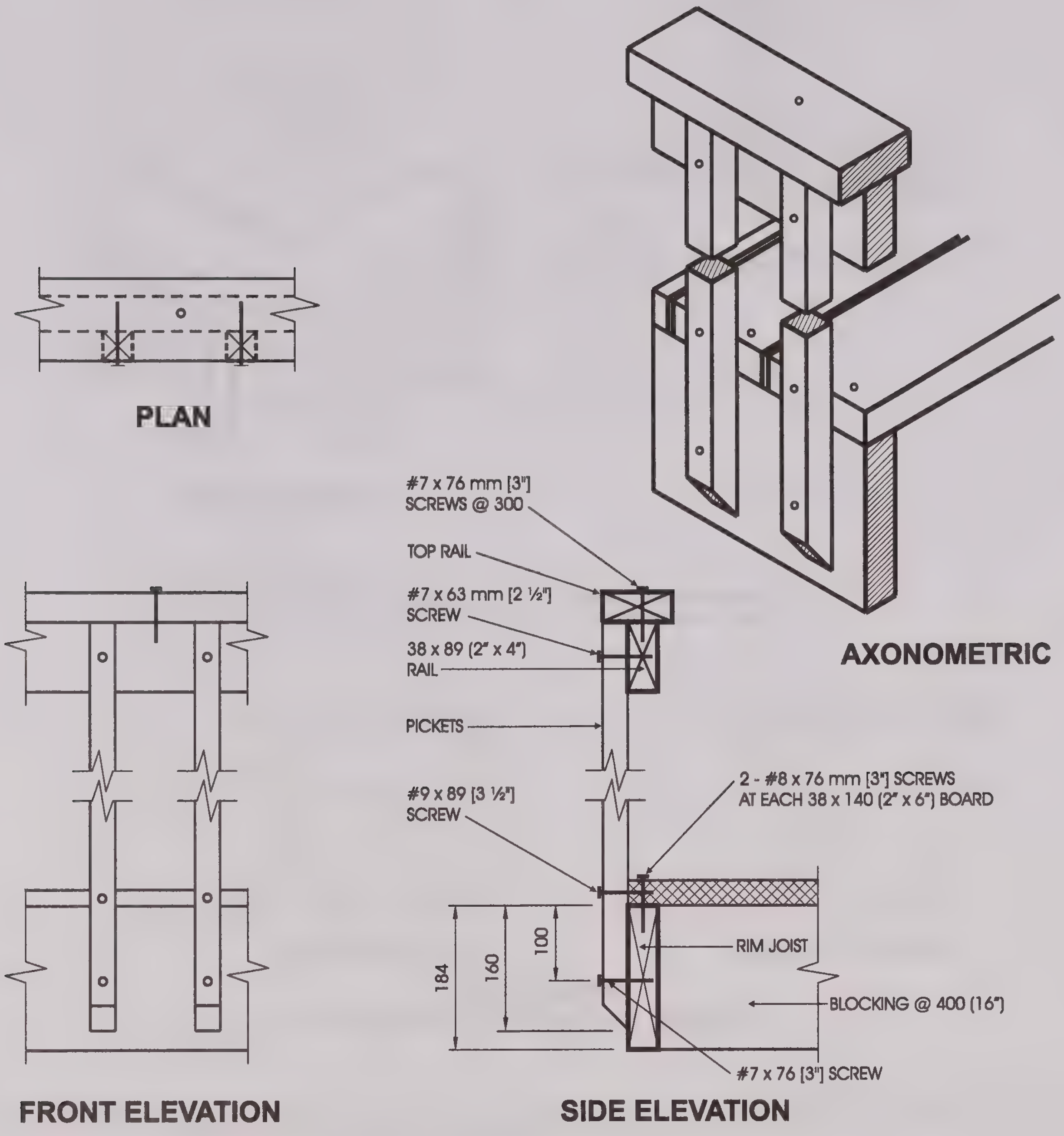


SIDE ELEVATION

Detail ED-3

Exterior Connection: Cantilevered Picket Screwed to Rim Joist and Deck

Notes:
1. Provide a suitable post, return, or solid support at each end of the guard.
2. Wood for cantilevered pickets shall be Northern Species.
3. Fasten rim joist to each floor joist with 3- 82 mm (31/4") nails.
4. Dimensions shown are in mm unless otherwise specified.

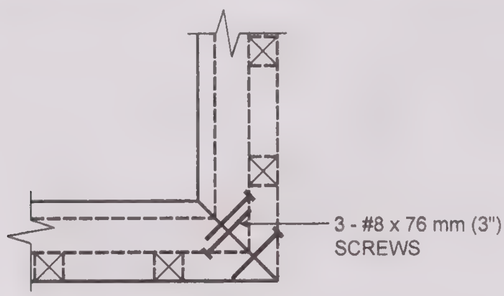


Detail ED-4

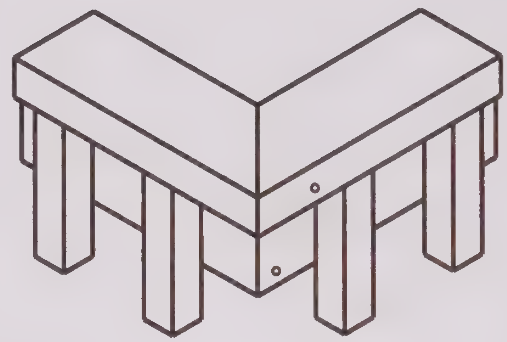
Exterior Connection: Cantilevered Picket Screwed to Rim Joist and Deck, Guard Parallel to Floor Joists

Notes:

1. Provide a suitable post, return, or solid support at each end of the guard.
2. Wood for cantilevered pickets shall be Northern Species.
3. Fasten rim joist to blocking with 3 - 82 mm (31/4") nails.
4. Dimensions shown are in mm unless otherwise specified.

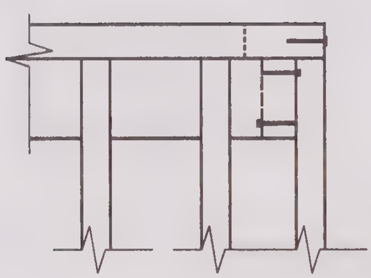


PLAN TOP RAIL

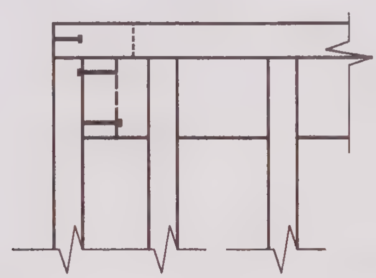


AXONOMETRIC

ONE FASTENER IN HORIZONTALLY ORIENTATED PORTION OF TOP RAIL AND TWO IN VERTICALLY ORIENTATED PORTION.



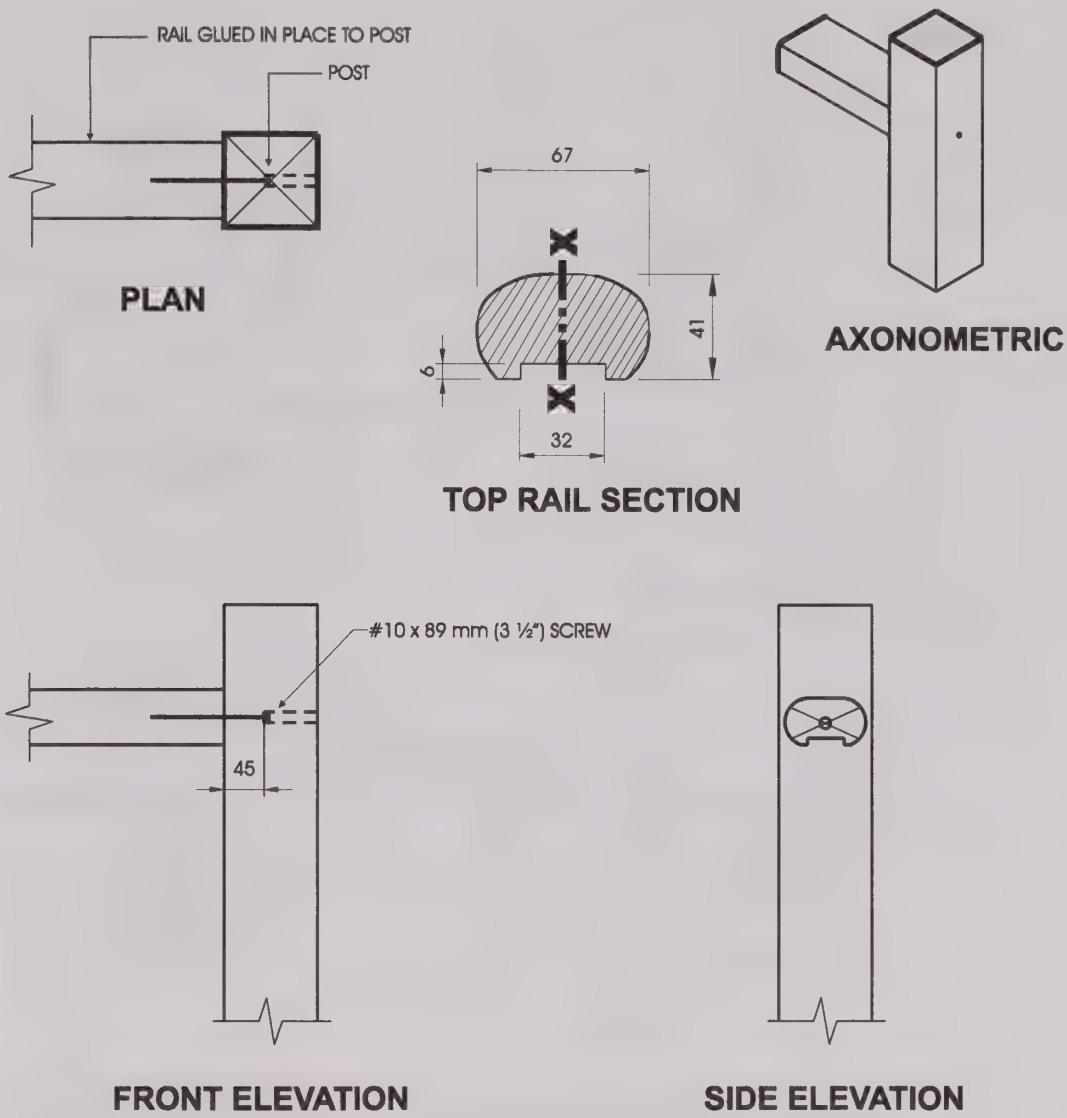
FRONT TOP RAIL



SIDE TOP RAIL

Detail ED-5
Exterior Connection: Corner Joint

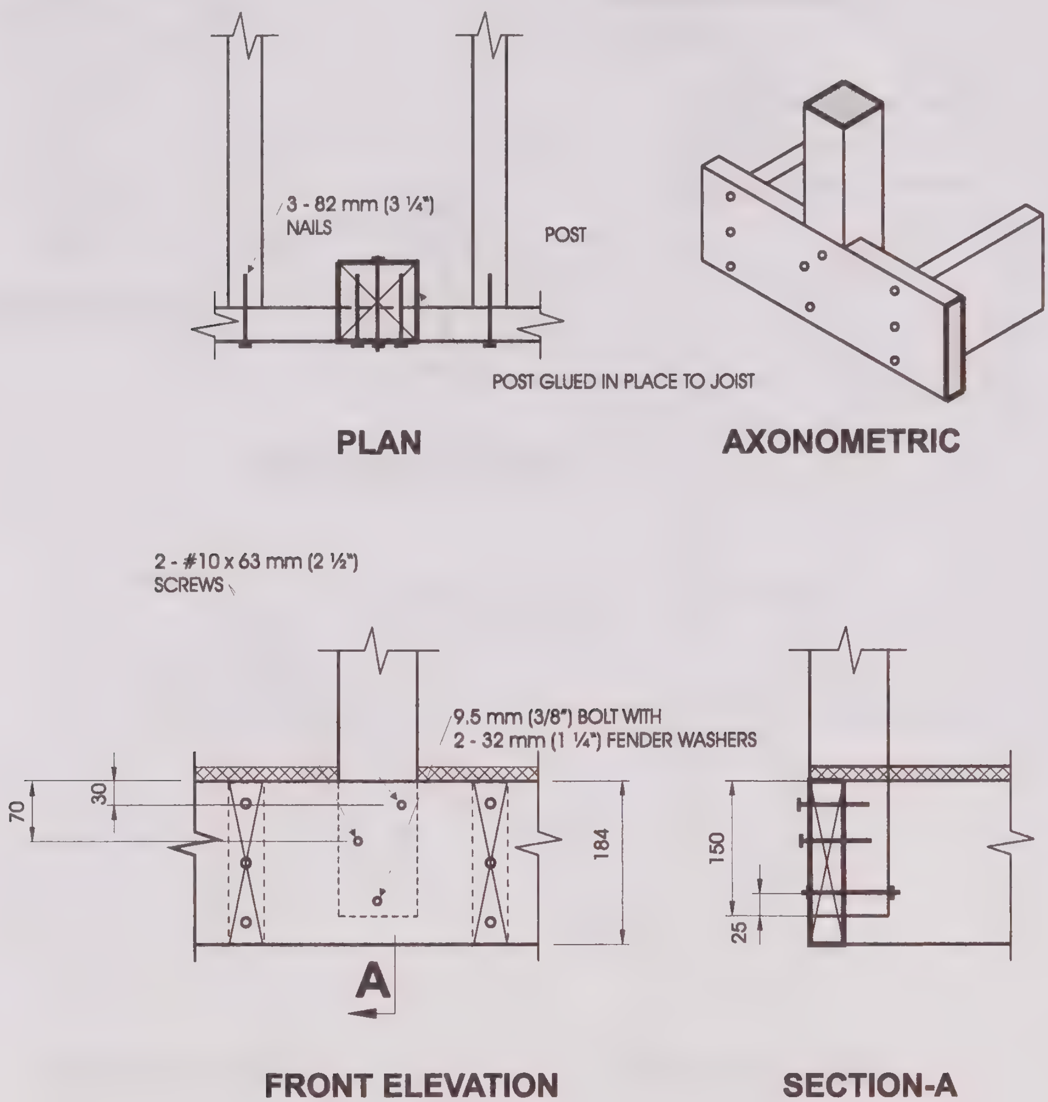
Notes:
1. Screws fastening pickets are omitted for clarity.
2. Provide a minimum of 10 pickets beyond the return if end restraint of the guard is provided by this return detail only.



Detail IA-1
Interior Connection: Rail Glued and Screwed to Post

Notes:
1. Other top rail systems may be used provided the section modulus is not less than 24,000 mm3, measured about the x-x axis.
2. Pickets omitted on drawing for clarity.
3. Connection details for fastening of pickets to rails are shown on Details IC-1 and IC-2.
4. Dimensions shown are in mm unless otherwise specified.

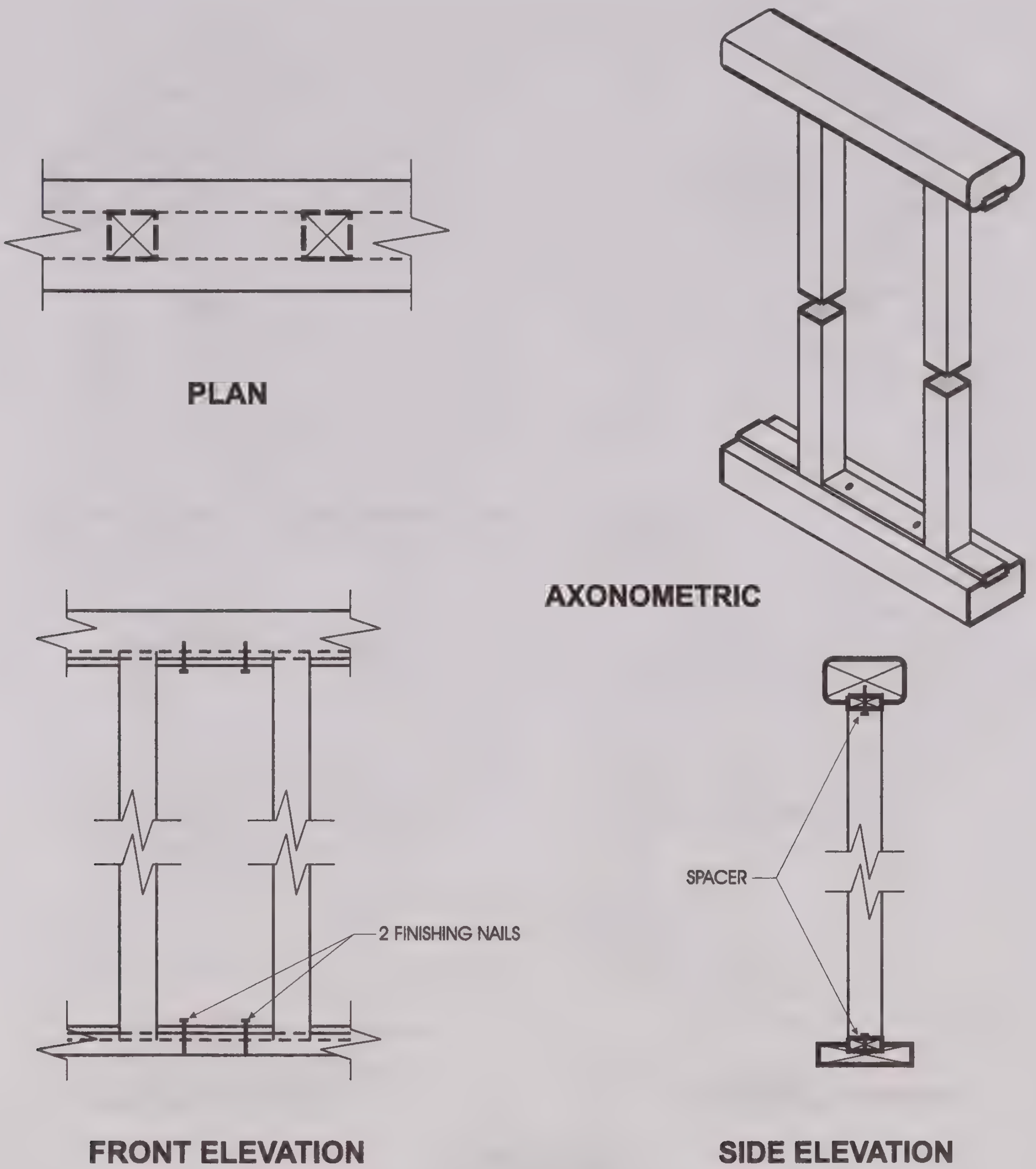
MAXIMUM SPAN OF RAIL BETWEEN POSTS	
Species	Maximum Span, m (ft-in)
Oak, Maple	3.30 (10'-10")
Column 1	2



Detail IB-1
Interior Connection: Notched Post Glued and Bolted to Rim Joist

Notes:
1. Minimum dimension of post is 82 mm x 82 mm (31/4" x 31/4").
2. Notch post 38 mm x 152 mm (11/2" x 6") at rim joist.
3. Dimensions shown are in mm unless otherwise specified.

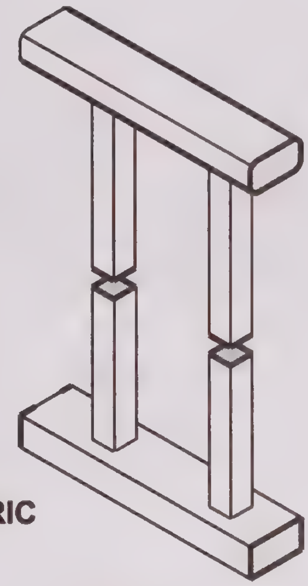
MAXIMUM SPACING BETWEEN POSTS	
Post Species	Maximum Span, m (ft-in)
Oak, Maple, Yellow Poplar, Hemlock, White Pine	3.30 (10'-10")
Column 1	2



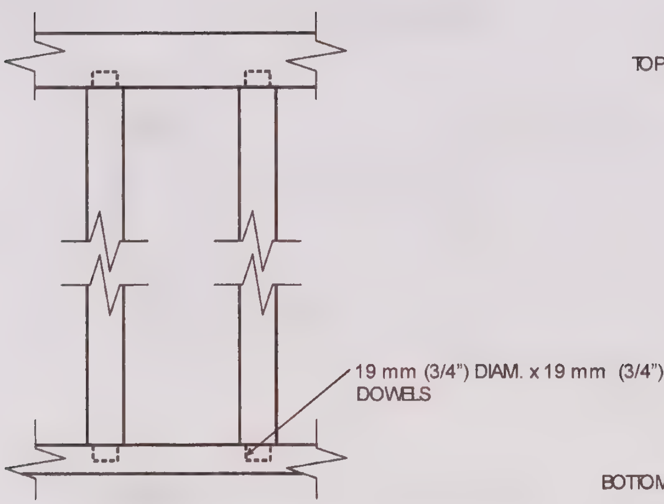
Detail IC-1
Interior Connection: Infill Picket Set into Rails

Notes:
1. See Table 3.1.2. for minimum sizes of pickets.
2. For top and bottom rail provide 6 mm (1/4") deep rabbet.

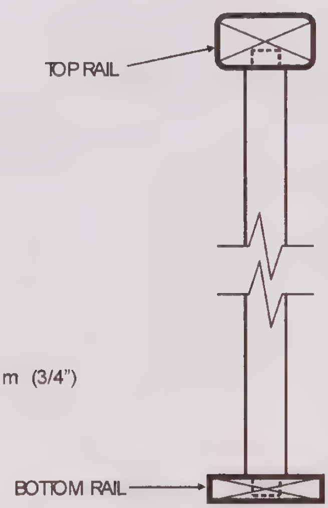
PLAN



AXONOMETRIC



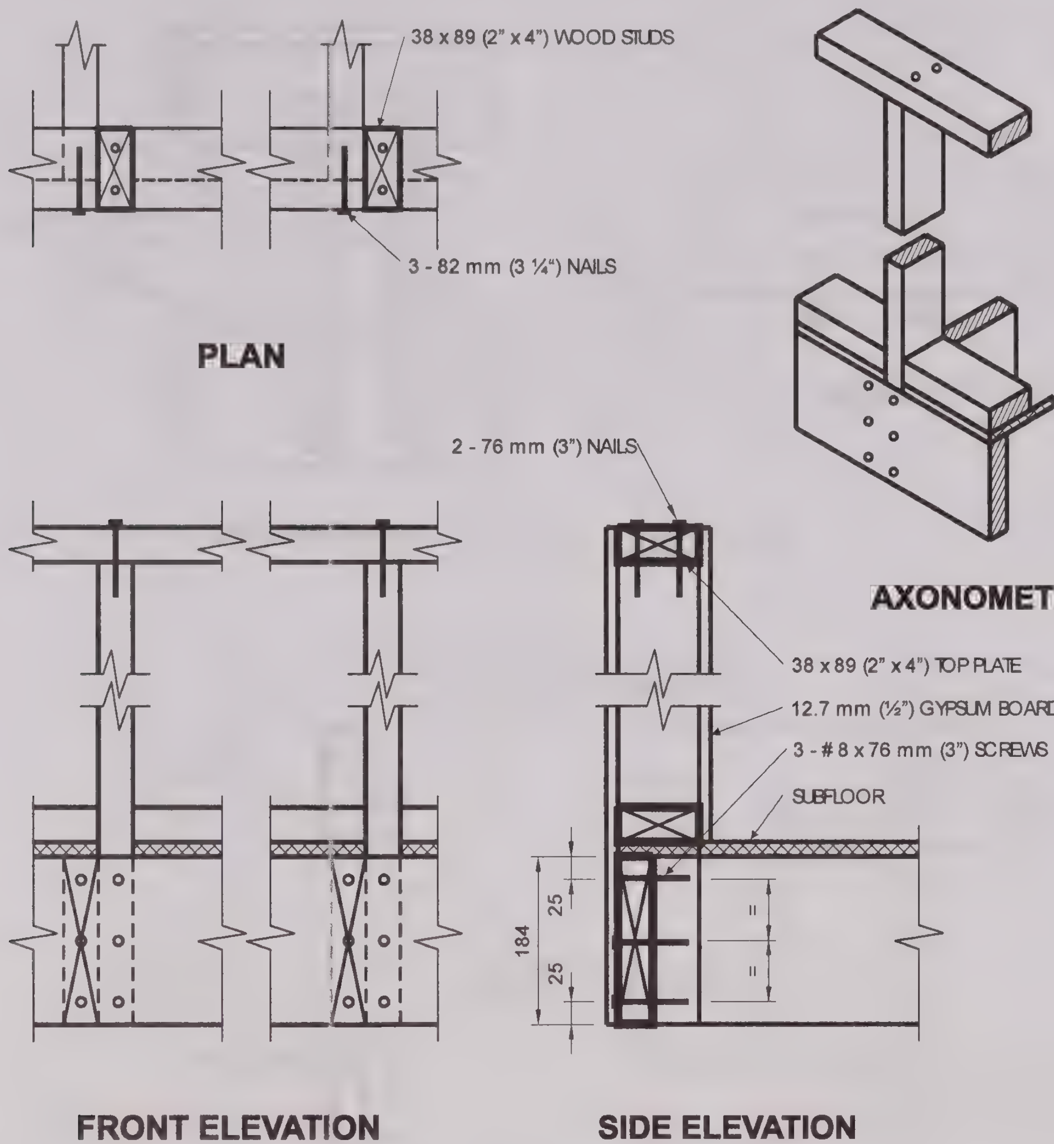
FRONT ELEVATION



SIDE ELEVATION

Detail IC-2
Interior Connection: Infill Picket Dowelled into Rails

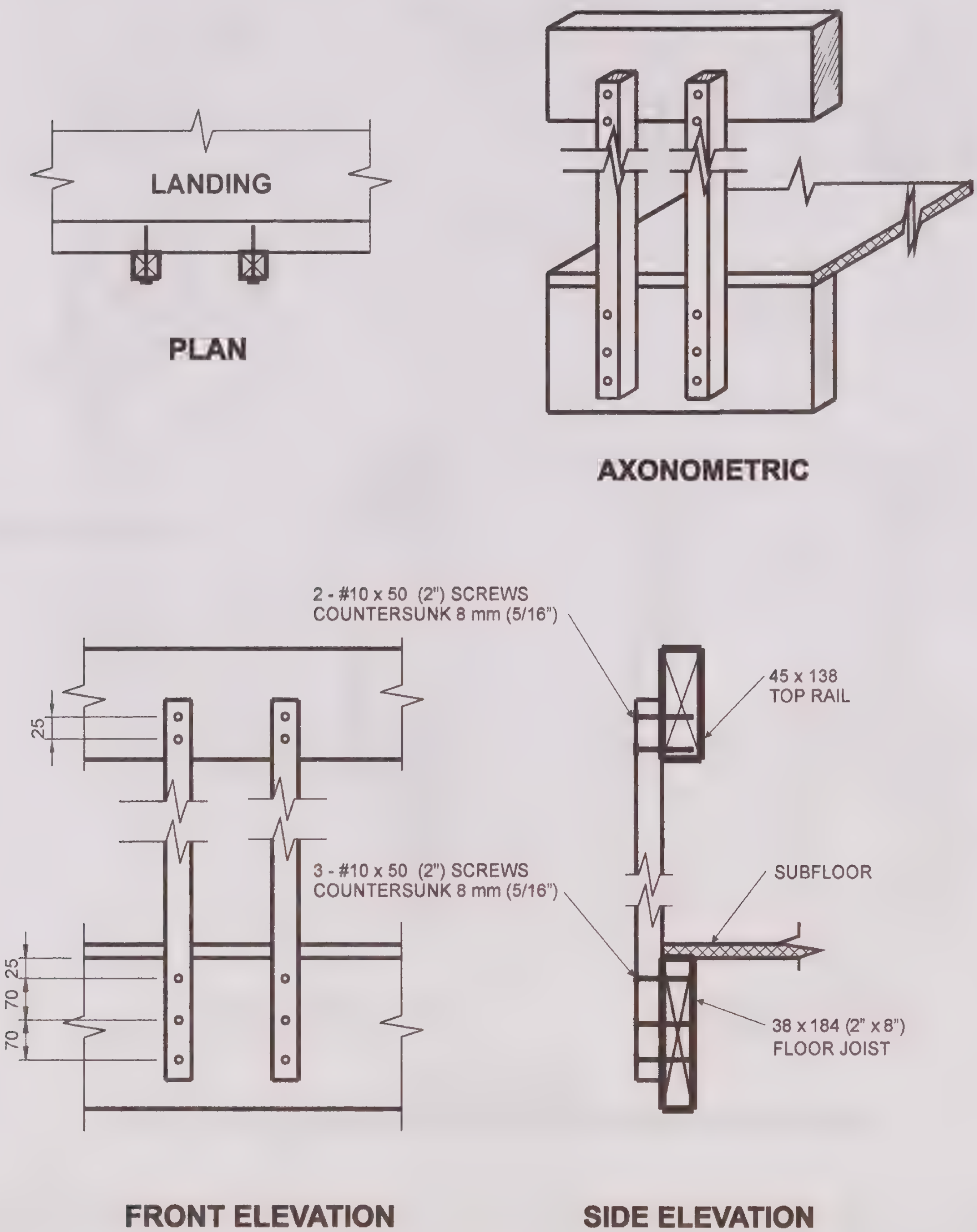
Notes:
1. See Table 3.1.2 for minimum sizes of pickets.
2. Pickets dowelled 19 mm (3/4") deep into rails with 19 mm (3/4") diameter dowels.



Detail ID-1
Interior Connection: Wood Stud and Gypsum Board Guard

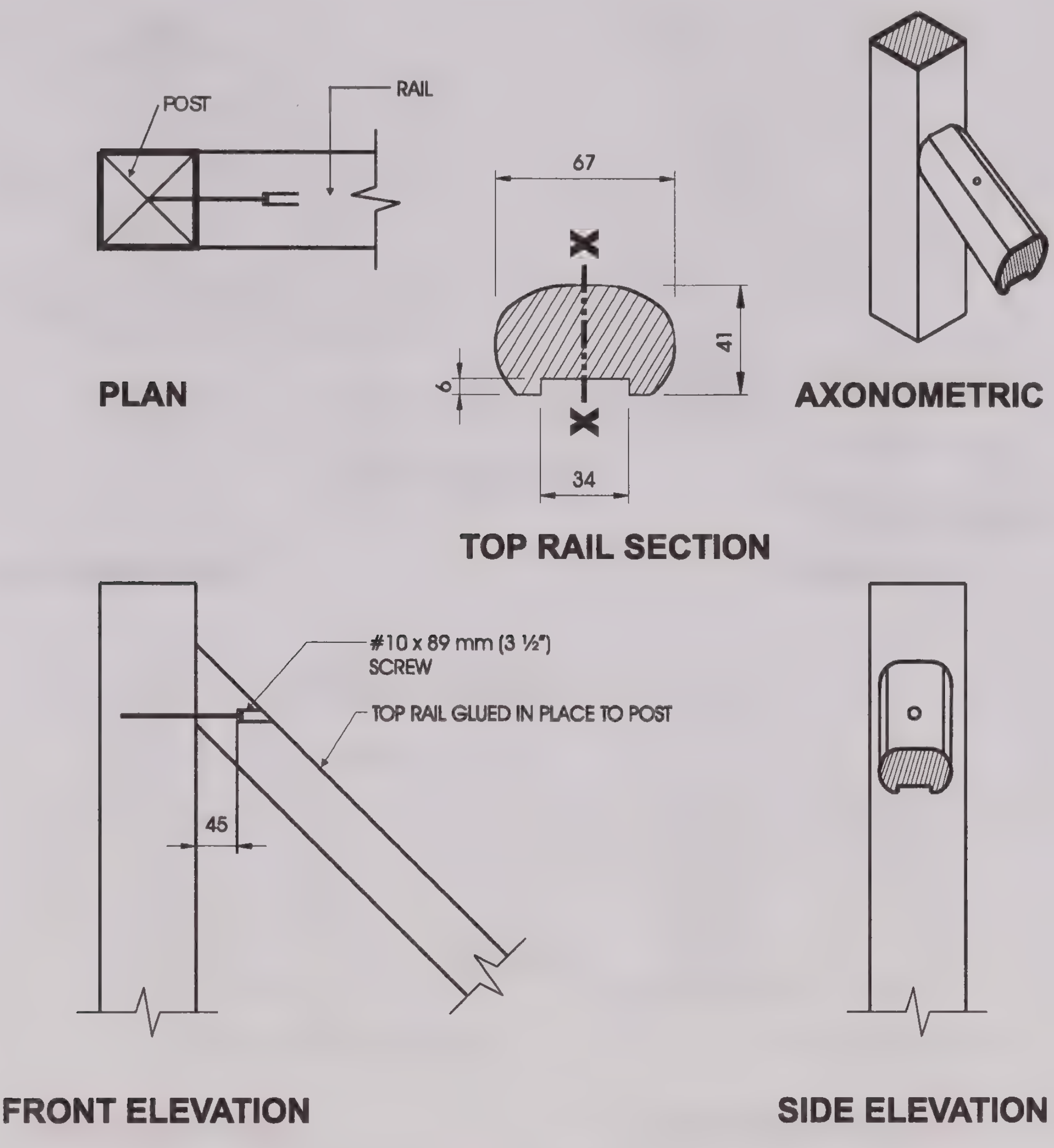
Notes:
1. Fasten plywood subfloor to joists with 50 mm (2") nails at 150 mm (6") oc along edges and at 300 mm (12") oc along intermediate supports.
2. Gypsum board omitted on plan, front elevation, and axonometric for clarity.
3. Dimensions shown are in mm unless otherwise specified.
4. Provide a suitable post, return, or solid support at each end of the guard.

MAXIMUM SPACING BETWEEN WOOD STUDS	
Stud Species	Maximum Spacing, mm (in)
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir, Northern Species	406 (16")
Column 1	2



Detail IE-1
Interior Connection: Cantilevered Picket Screwed to Rim Joist

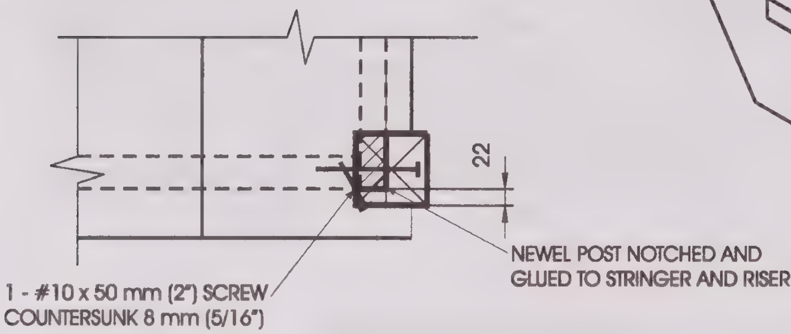
Notes:
1. Provide a suitable post, return, or solid support at each end of the guard.
2. See Table 3.1.2. for minimum sizes of pickets.
3. Dimensions shown are in mm unless otherwise specified.
4. Rim joist and top rail of oak or maple.



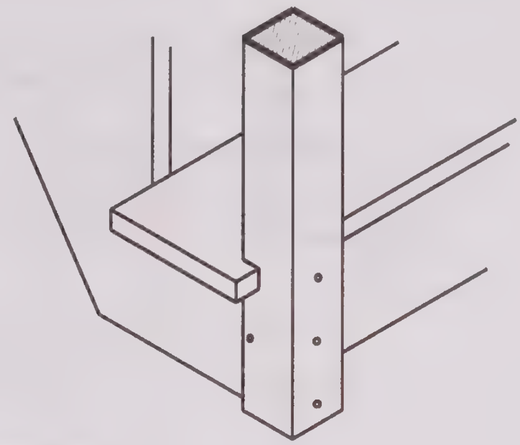
Detail IF-1
Interior Stair Guard Connection: Top/Bottom Rail Glued and Screwed to Post

Notes:
1. Maximum permitted span is based on a slope between 35° and 45° from the horizontal.
2. Minimum section modulus of top rail shall be 24,000 mm3, measured about the x-x axis.
3. Pickets omitted on drawing, for clarity.
4. Detail IC-1 or Detail IC-2, modified to suit a sloping application may be used for picket to rail connections.

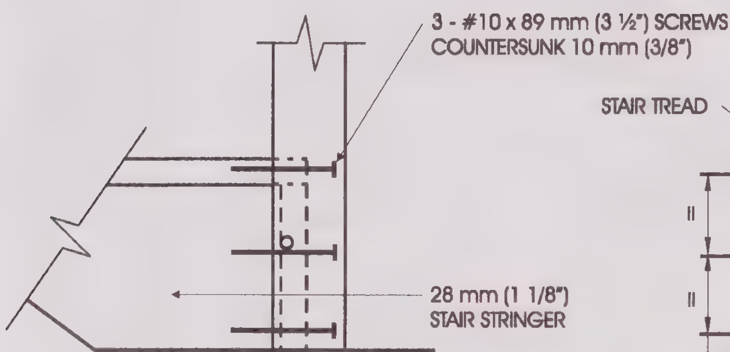
MAXIMUM SPAN OF RAIL, MEASURED ALONG THE SLOPE	
Rail Species	Maximum Span, m (ft-in)
Oak, Maple	4.30 (14'-1")
Column 1	2



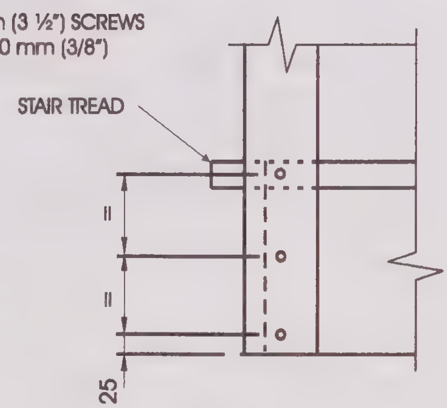
PLAN



AXONOMETRIC



FRONT ELEVATION



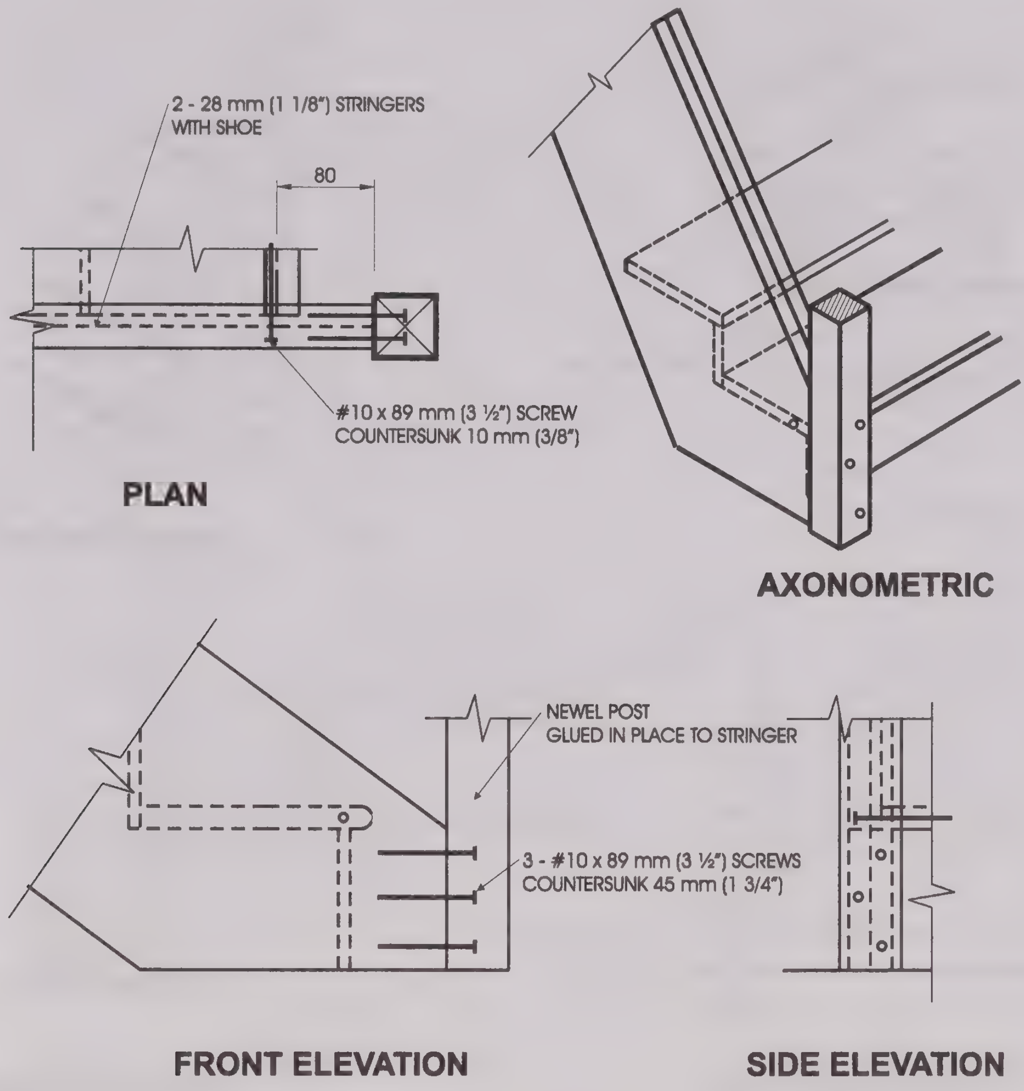
SIDE ELEVATION

Detail IG-1

Interior Stair Guard Connection: Notched Post Glued & Screwed to Stringer & Riser

Notes:
1. Stringer shall be oak or maple.
2. Notch post 38 mm x 60 mm (11/2” x 23/8”) to fit over stair stringer.
3. Only the first riser and tread are shown, for clarity.
4. Minimum thickness of riser shall be 12 mm (1/2”).
5. Detail IC-1 or Detail IC-2, modified to suit a sloping application may be used for picket to rail connections.
6. Dimensions shown are in mm unless otherwise specified.

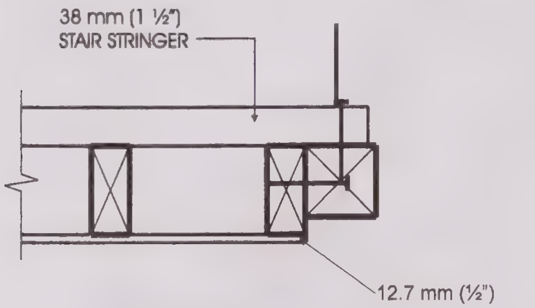
MAXIMUM SPACING BETWEEN POSTS	
Post Species	Maximum Span, m (ft-in)
Oak, Maple, Yellow Poplar, Hemlock, White Pine	3.30 (10'-10")
Column 1	2



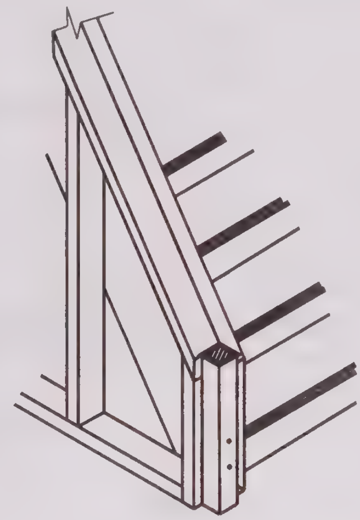
Detail IG-2
Interior Stair Guard Connection: Post Glued and Screwed to Stringer

Notes:
1. Stringer shall be oak or maple.
2. Only the first riser and tread are shown, for clarity.
3. Minimum thickness of riser shall be 12 mm (1/2").
4. Detail IC-1 or Detail IC-2, modified to suit a sloping application may be used for picket to rail connections.
5. Dimensions shown are in mm unless otherwise specified.

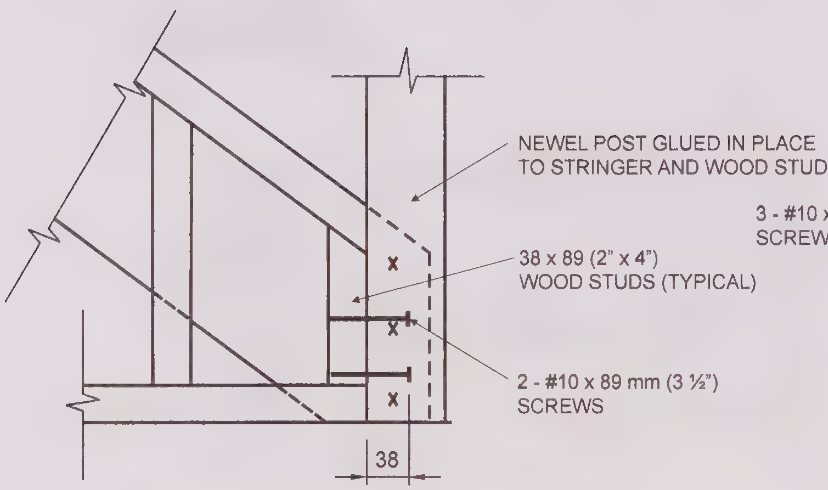
MAXIMUM SPACING BETWEEN POSTS	
Post Species	Maximum Span, m (ft-in)
Oak, Maple, Yellow Poplar, Hemlock, White Pine	3.30 (10'-10")
Column 1	2



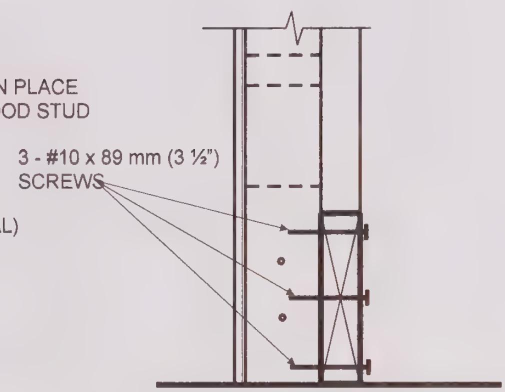
PLAN



AXONOMETRIC



FRONT ELEVATION



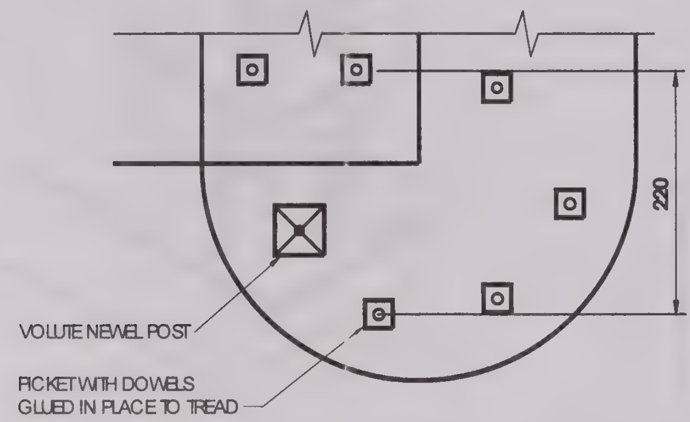
SIDE ELEVATION

Detail IG-3

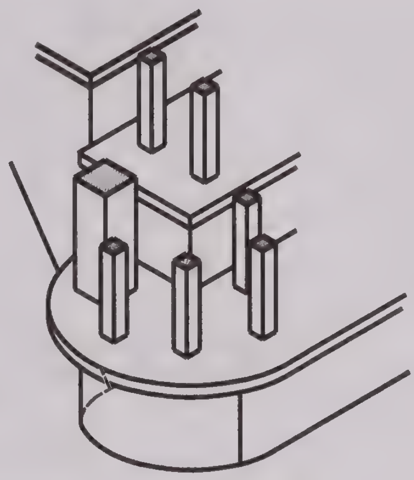
Interior Stair Guard Connection: Post Glued and Screwed to Stringer and Stud Wall

Notes:
1. Minimum thickness of riser shall be 12 mm (½").
2. Detail IC-1 or Detail IC-2, modified to suit a sloping application may be used for picket to rail connections.
3. Dimensions shown are in mm unless otherwise specified.

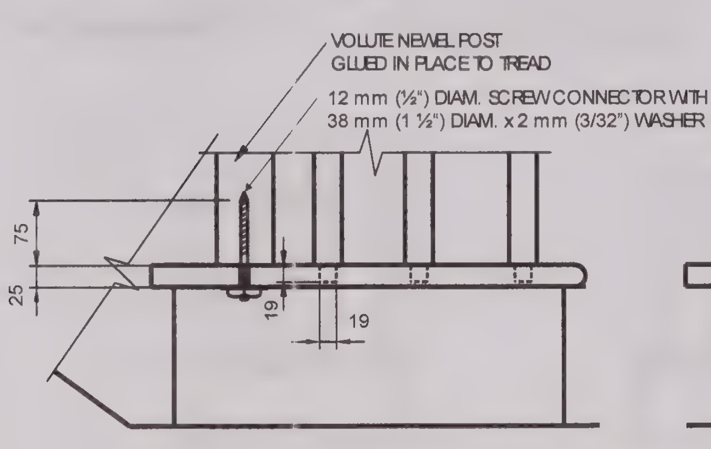
MAXIMUM SPACING BETWEEN POSTS	
Post Species	Maximum Span, m (ft-in)
Oak, Maple, Yellow Poplar, Hemlock, White Pine	3.30 (10'-10")
Column 1	2



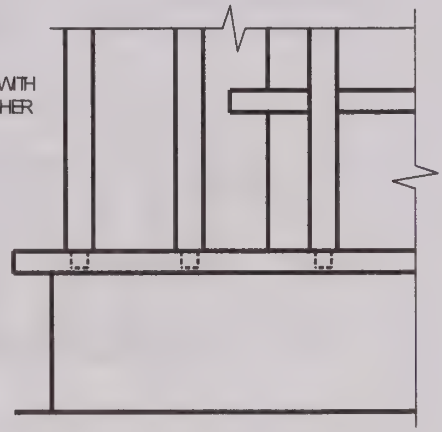
PLAN



AXONOMETRIC



FRONT ELEVATION



SIDE ELEVATION

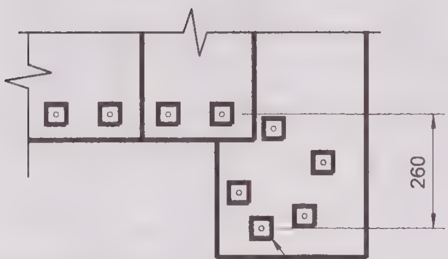
Detail IG-4

Interior Stair Guard Connection: Oak or Maple Post and Picket Volute

Notes:

1. Maximum permitted span is measured from the centre of the volute to a post or other solid support.
2. Other top rail systems may be used provided that the section modulus is not less than 24,000 mm3, measured about the vertical axis.
3. Newel post and pickets in the volute shall be oak or maple. See Table 3.1.2. for minimum sizes of pickets.
4. Detail IC-1 or Detail IC-2, modified to suit a sloping application may be used for picket to rail connections.
5. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPAN OF RAIL, MEASURED ALONG THE SLOPE	
Post and Picket Species	Maximum Span, m (ft-in)
Oak, Maple	4.30 (14'-1")
Column 1	2



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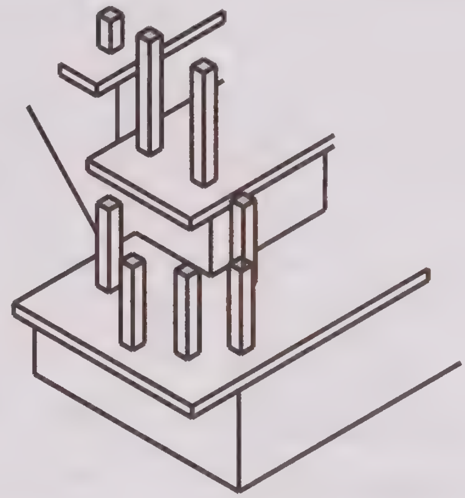

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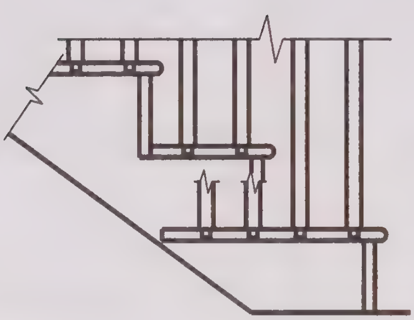
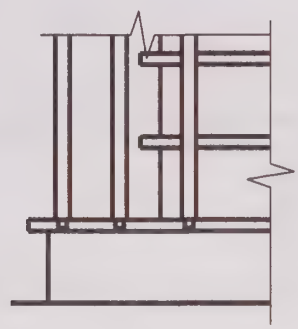


FRONT ELEVATION



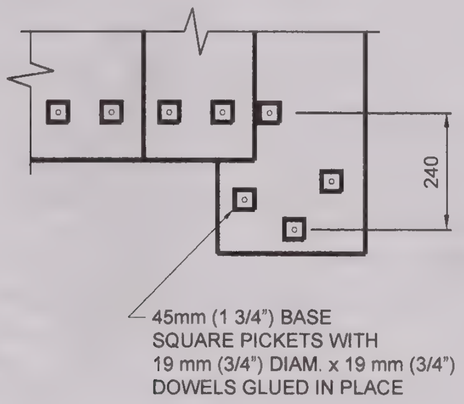
SIDE ELEVATION

Detail IG-5

Interior Stair Guard Connection: Picket Volute, 260 mm (101/4") Wide

Notes:
1. Maximum permitted span is measured from the centre of the volute to a post or other solid support.
2. Other top rail systems may be used provided that the section modulus is not less than 24,000 mm3, measured about the vertical axis.
3. See Table 3.1.2. for minimum sizes of pickets.
4. Detail IC-1 or Detail IC-2, modified to suit a sloping application may be used for picket to rail connections.
5. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPAN OF RAIL	
Picket Species	Maximum Span, m (ft-in)
Yellow Poplar, Hemlock, White Pine	1.80 (5'-11")
Column 1	2



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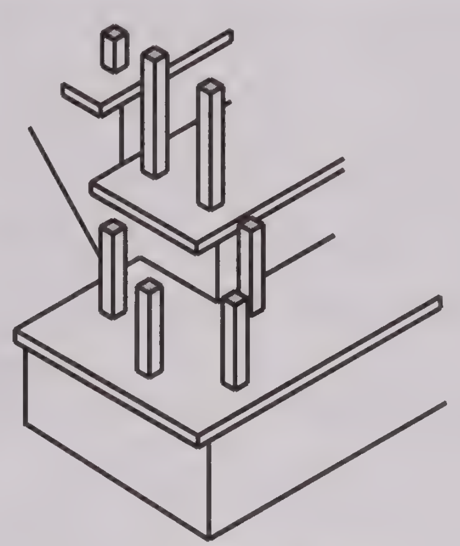

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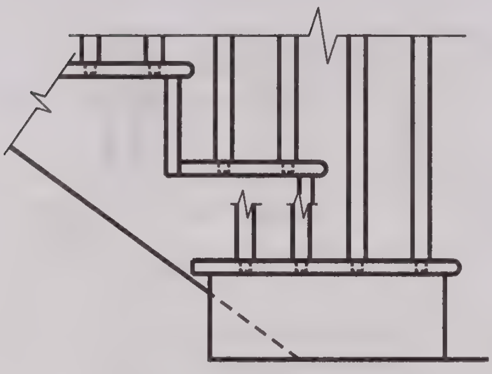
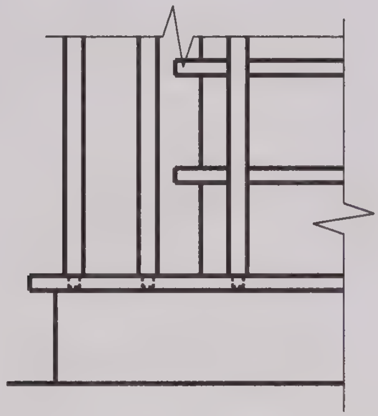


FRONT ELEVATION

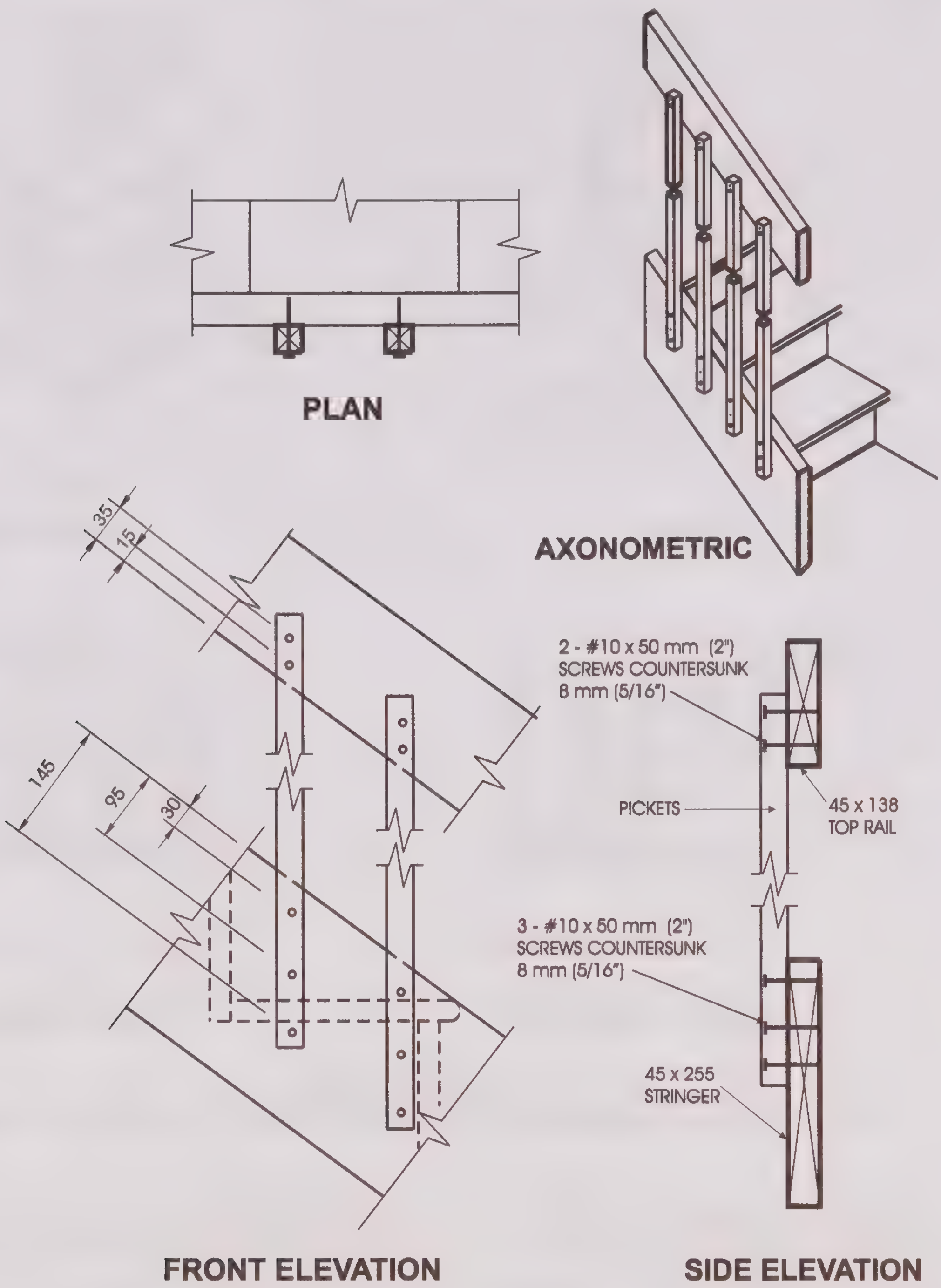


SIDE ELEVATION

Detail IG-6
Interior Stair Guard Connection: Picket Volute, 240 mm (91/2") Wide

Notes:
1. Maximum permitted span is measured from the centre of the volute to a post or other solid support.
2. Other top rail systems may be used provided that the section modulus is not less than 24,000 mm3, measured about the vertical axis.
3. See Table 3.1.2. for minimum sizes of pickets.
4. Detail IC-1 or Detail IC-2, modified to suit a sloping application may be used for picket to rail connections.
5. Dimensions shown are in mm unless otherwise specified.

MAXIMUM SPAN OF RAIL	
Species	Maximum Span, m (ft-in)
Yellow Poplar, Hemlock, White Pine	1.80 (5'-11")
Column 1	2



Detail IH-1

Interior Stair Guard Connection: Cantilevered Picket Screwed to Stair Stringer

Notes:
1. Stair stringer shall be oak or maple.
2. Provide a suitable post, return, or solid support at each end of the guard.
3. See Table 3.1.2. for minimum sizes of pickets.
4. Dimensions shown are in mm unless otherwise specified.

Section 3 Interior Guards

3.1. Materials

3.1.1. Lumber and Wood Products

(1) Lumber species used for a primary loadbearing element in a guard shall be a species listed in the Table 3.1.2.

(2) Except as provided in Sentence (4), the minimum grade of softwood dimension lumber for posts, rails and joists shall be Northern Species, No. 2.

(3) Except as provided in Sentence (4), the minimum grade of softwood dimension lumber for cantilevered pickets shall be Northern Species, No. 2 Picket grade.

(4) White pine and hemlock lumber used for posts, rails and non-cantilevered pickets shall be clear straight grain material.

(5) Oak, maple and yellow poplar lumber used for posts, rails and pickets shall be clear straight grain material.

3.1.2. Lumber Dimensions

(1) The minimum sizes of loadbearing elements of wood guards shall conform to Table 3.1.2.

3.1.3. Floor Construction

(1) The minimum dimensions of wood floor joists and wood subflooring shall conform to Table 3.1.3. (See A-2.1.3. in Appendix A.)

3.1.4. Connectors

(1) Nails, screws, lag bolts and machine bolts shall not cause splitting of the wood elements. (See A-2.1.4. in Appendix A.) (See also A-2.1.4. in Appendix A for glued joints.)

3.2. Structural Details

3.2.1. Post and Rail System

(1) An interior guard constructed as a Post and Rail System shall conform to the applicable connection details listed in Table 3.2.1.

3.2.2. Cantilevered Picket System

(1) An interior guard constructed as a Cantilevered Picket System shall conform to the applicable connection details listed in Table 3.2.2.

3.2.3. Guards for Stairs

(1) An interior guard for a stair shall conform to the appropriate connection details listed in Table 3.2.3.

Table 3.1.2
Minimum Size of Loadbearing Elements

Guard Element	Species	Minimum Size, mm (in)	Detail Number[(1)]
Post	Oak, Maple	70 x 70 ($2^{3}/_{4}$" x $2^{3}/_{4}$") Base, 45 ($1^{3}/_{4}$") Turned Diameter	IB-1, IG-1, IG-2, IG-3
	Hemlock, White Pine, Yellow Poplar	82 x 82 ($3^{1}/_{4}$" x $3^{1}/_{4}$") Base, 50 (2") Turned Diameter	IB-1, IG-1, IG-2, IG-3
Post in a Volute	Oak, Maple	70 x 70 ($2^{3}/_{4}$" x $2^{3}/_{4}$") Base, 50 (2") Turned Diameter	IG-4
Top Rail	Oak, Maple	41 x 67 ($1^{5}/_{8}$" x $2^{5}/_{8}$")	IA-1, IF-1
Bottom Rail	Oak, Maple	41 x 67 ($1^{5}/_{8}$" x $2^{5}/_{8}$")	
		19 x 67 ($^{3}/_{4}$" x $2^{5}/_{8}$"), if continuously supported	
Infill Picket	Oak, Maple	20 ($^{3}/_{4}$") Diameter	IC-1, IC-2
	Yellow Poplar	22 ($^{7}/_{8}$") Diameter	
	White Pine, Hemlock	24 ($^{31}/_{32}$") Diameter	
Picket in a Volute	Oak, Maple	32 x 32 ($1^{9}/_{32}$" x $1^{9}/_{32}$") Base, 20 ($^{3}/_{4}$") Turned Diameter	IG-4
	Yellow Poplar	45 x 45 ($1^{3}/_{4}$" x $1^{3}/_{4}$") Base, 22 ($^{7}/_{8}$") Turned Diameter	IG-5, IG-6
	White Pine, Hemlock	45 x 45 ($1^{3}/_{4}$" x $1^{3}/_{4}$") Base, 24 ($^{31}/_{32}$") Turned Diameter	
Cantilevered Picket	Northern Species, Douglas Fir-Larch, Spruce-Pine-Fir, Hem-Fir, Hardwood	32 x 32 ($1^{9}/_{32}$" x $1^{9}/_{32}$")	IE-1, IH-1
Column 1	2	3	4

Notes to Table 3.1.2.:

1. This column lists details that incorporate the guard elements specified in this Table.

Table 3.1.3
Minimum Size of Floor Elements

Floor Element	Minimum size, mm (in)
Subfloor	15.5 ($^{5}/_{8}$") plywood or equivalent
Dimension Lumber Joists	38 x 184 (2" x 8" nominal)
Column 1	2

Table 3.2.1
Interior Post and Rail System Connection Details

Connection Detail	Detail Number	Description
Top and/or Bottom Rail to Post	IA-1	Rail glued and screwed to post
Post to Floor	IB-1	Notched post glued and bolted to rim joist
Infill Picket	IC-1	Picket set into rails
	IC-2	Picket dowelled into rails
Stud Wall	ID-1	Wood stud and gypsum board
Column 1	2	3

Table 3.2.2.
Interior Cantilevered Picket System Connection Details

Connection Detail	Detail Number	Description
Picket to Floor	IE-1	Picket screwed to rim joist
Column 1	2	3

Table 3.2.3
Interior Stair Guard Connection Details

Connection Detail	Detail Number	Description
Rail to Post	IF-1	Top or bottom rail glued and screwed to post
Post to Floor and/or Picket Volute to Floor	IG-1	Notched post glued and screwed to stringer and riser
	IG-2	Post glued and screwed to stringer
	IG-3	Post glued and screwed to stringer and stud wall
	IG-4	Post and picket volute, oak or maple
	IG-5	Picket volute, 260 mm ($10^1/_4$") wide
	IG-6	Picket volute, 240 mm ($9^1/_2$") wide
Infill Picket	Detail IC-1 or IC-2 in Table 3.2.1., modified to suit a sloping installation, may be used.	
Cantilevered Picket	IH-1	Picket screwed to stair stringer
Column 1	2	3

Appendix A

Explanatory Material for SB-7

Appendix A to this Supplementary Standard is included for explanatory purposes only and does not form part of the requirements. The bold-faced reference numbers that introduce each item apply to the requirements in this Supplementary Standard.

A-1.1.1. Scope. A guard constructed in conformance with this Supplementary Standard is deemed to satisfy the requirements of Sentence 9.8.8.8.(2) of Division B.

Guard design in this Supplementary Standard is based on a height of 1 070 mm and a maximum clear spacing of 100 mm between pickets or balusters.

A-1.1.1.(2) Guards located on the exterior of a building are subject to deterioration as a result of hygrothermal, electrochemical or biochemical action.

A-1.2.1. Cantilever Action. Where guards incorporate wood posts that are continuous from the top of the guard to the ground, or where the tops of the posts are attached to a superstructure that is connected to the building, the cantilever assumption in the Supplementary Standards is no longer valid. An example of a continuous post is shown in Figure A-1.2.1.

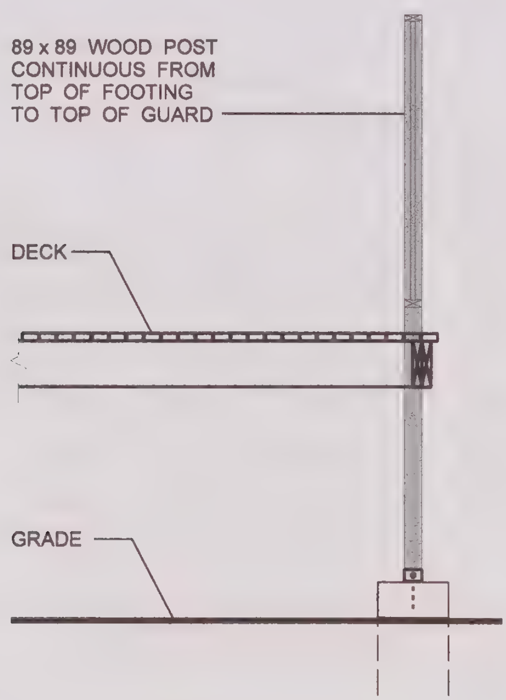


Figure A-1.2.1.
Typical Continuous Post

A-1.2.2. Classification. A Post and Rail System consists of a top rail that transfers horizontal loads to posts. The posts transfer the loads from the rail to the floor system. This system may incorporate a bottom rail that is anchored at each end to the posts. Infill panels or infill pickets are installed between the top rail and the floor or bottom rail. Examples of Post and Rail Systems are shown in Figure A-1.2.2.A.

The term "infill pickets" refers to an assembly of vertically oriented elements that span between the floor or bottom rail and the top rail. For the purpose of this Supplementary Standard, the words "picket" and "baluster" both relate to these individual elements.

The spacing of the posts in a Post and Rail System is detailed in this Supplementary Standard and is dictated by the ability of the posts to accept the design loads. The maximum spanning capacity of the rails is often not realised because it is dictated by the post spacing.

A Cantilevered Picket System consists of a top rail that transfers horizontal loads to pickets. The pickets transfer the loads from the top rail to the floor system. An example of a Cantilevered Picket System is shown in Figure A-1.2.2.B.

A guard classified as a Post and Rail System or a Cantilevered Picket System need not always terminate at a post if:
- (a) the top rail is connected adequately to an element capable of accepting the forces applied to it, or
- (b) the guard changes direction and the rails are adequately fastened at the return.

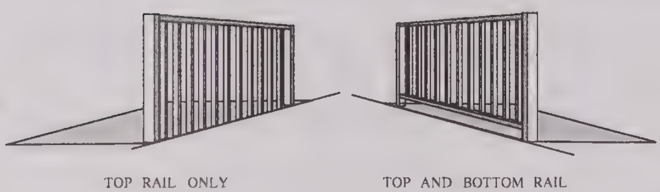


Figure A-1.2.2.A Typical Post and Rail System

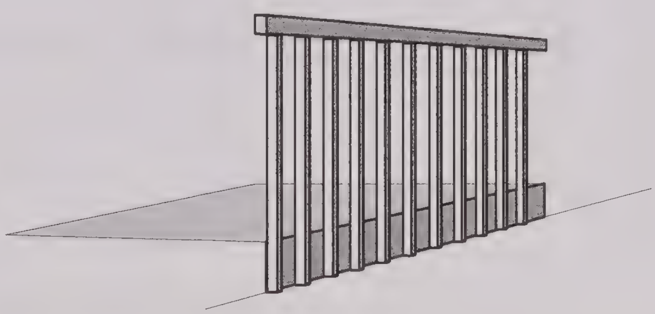


Figure A-1.2.2.B Cantileverd Picket System

A-2.1.1. Lumber Grades. Whereas Northern Species is specified as the minimum lumber grade, Spruce-Pine-Fir, Douglas Fir-Larch and Hem-Fir may also be used since their structural properties exceed those of Northern Species. Cedar falls within the classification of Northern Species Group.

A-2.1.3. Floor Construction. The lateral loads acting on a guard are transferred from either the posts or the pickets to the floor system. Therefore, the floor system must be sufficiently strong to transfer these loads.

A-2.1.4. Connectors. Pre-drilling of wood elements may be required in order to avoid splitting of structural wood elements. Where a glued joint is required, an adhesive conforming to CSA Standard O112.4-M1977 (Polyvinyl Adhesives for Wood) and CSA Standard O112.8-M1977 (Polyvinyl Adhesives - Cross Linking, for Wood) is acceptable.

A-2.1.5. Decay-Resistant Lumber. Cedar is a species considered resistant to decay.

SB-9 Requirements for Soil Gas Control

Section 1 Soil Gas Control in Masonry Walls

1.1. Sealing of Masonry Walls

(1) Masonry walls required to provide a barrier to soil gas ingress shall
(a) include a course of masonry units without voids, or
(b) be sealed with flashing material extending across the full width of the masonry.

(2) The masonry course or flashing described in Sentence (1) shall
(a) be located at the level of the adjoining floor and be sealed to it in accordance with Subsection 3.3., or
(b) in the absence of a floor, be located at the level of the ground cover required by Article 9.18.6.1. of Division B of the Building Code and be sealed to it.

Section 2 Soil Gas Control in Underground Roofs

2.1. Sealing of Underground Roofs

(1) Waterproofing systems for roofs of underground structures shall be sealed to the soil gas barrier in the walls.

Section 3 Soil Gas Control in Floors

3.1. Soil Gas Barriers in Floors

(1) Where the floor-on-ground is a concrete slab, the soil gas barrier shall be
(a) installed below the slab, or
(b) applied to the top of the slab, provided a separate floor is installed over the slab.

(2) Where the soil gas barrier is installed below a slab-on-ground, joints in the barrier shall be lapped not less than 300 mm.

(3) Where the soil gas barrier is installed above a slab-on-ground, joints in the barrier shall be sealed.

(4) Where installed in conjunction with a framed floor-on-ground, the soil gas barrier shall be installed in accordance with Articles 9.25.3.2. and 9.25.3.3. of Division B of the Building Code.

3.2. Providing for Subfloor Depressurization

(1) Except as required in Sentence (3), granular material shall be installed below the floor-on-ground according to Sentence 9.16.2.1.(1) of Division B of the Building Code.

(2) A pipe not less than 100 mm in diameter shall be installed vertically through the floor, at or near its centre, such that
(a) its bottom end opens into the granular fill described in Sentence (1), and
(b) its top end will permit connection to depressurization equipment.

(3) The granular material described in Sentence (1), near the centre of the floor, shall be not less than 150 mm deep for a radius of not less than 300 mm centred on the pipe described in Sentence (2).

(4) The upper end of the pipe described in Sentence (2) shall be provided with a removable seal.

(5) The pipe described in Sentence (2) shall be clearly labelled to indicate that it is intended only for the removal of soil gas from below the floor-on-ground.

(6) Except as provided in Sentence (8), when a building constructed in accordance with Sentences (1) to (5) is complete, testing shall be conducted according to HC Pub. 4171, "Guide for Radon Measurements in Residential Dwellings (Homes), 2008", to determine the radon concentration in the building.

(7) A copy of the results of testing required in Sentence (6) shall be provided by the building owner to the authority having jurisdiction.

(8) The testing required in Sentence (6) shall include basement concentration measurements.

(9) Where the average annual radon concentration determined as described in Sentences (6) and (8) exceeds 200 Bq/m^3 in the normal occupancy area, a subfloor depressurization system shall be installed to reduce the radon concentration to a level below 200 Bq/m^3 in the normal occupancy area.

(10) Where a subfloor depressurization system is installed,
(a) makeup air shall be provided as specified in Article 9.32.3.8. of Division B of the Building Code, and
(b) measures shall be taken to ensure that any resultant decrease in soil temperature will not adversely affect the foundation.

3.3. Sealing of the Perimeter and Penetrations

(1) A floor-on-ground shall be sealed around its perimeter to the inner surfaces of adjacent walls using flexible sealant.

(2) All penetrations of a floor-on-ground by pipes or other objects shall be sealed against soil gas leakage.

(3) All penetrations of a floor-on-ground that are required to drain water from the floor surface shall be sealed in a manner that prevents the upward flow of soil gas without preventing the downward flow of liquid water.

Notes to SB-9 Soil Gas Barriers:

There are two principal methods of excluding soil gas:

- Sealing the interface between the soil and the occupied space, so far as is reasonably practicable.
- Ensuring that the pressure difference across the soil/space interface is positive (i.e., towards the outside) so that inward soil gas flow through any remaining leaks will be prevented.

Soil Gas Barriers. The requirements for Soil Gas Control in Walls, Soil Gas Barriers, and Sealing of the Perimeter and Penetrations, are illustrated in the following drawings. Sealing of penetrations of the slab also applies to hollow metal and masonry columns. Not only the perimeters but also the centres of such columns must be sealed or blocked.

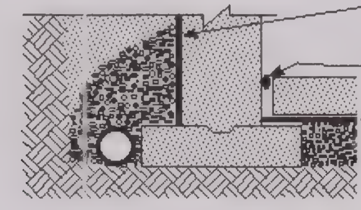


Figure SB-9A
Dampproofing Soil Gas Control at Foundation Wall/Floor Junctions with Solid Walls

The requirement regarding drainage openings in slabs can be satisfied with any of a number of proprietary devices which prevent soil gas entry through floor drains. Some types of floor drains incorporate a trap which is connected to a nearby tap so that the trap is filled every time the tap is used. This is intended to prevent the entry of sewer gas but would be equally effective against the entry of soil gas.

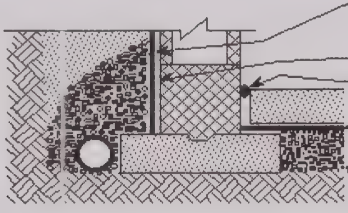


Figure SB-9B
Dampproofing and Soil Gas Control at Foundation Wall/Floor Junctions with Hollow Walls

SB-12 Energy Efficiency of Housing

FOREWORD[1]

This Supplementary Standard has been included as a design option in Sentences 12.2.1.1.(3) and 12.2.1.2.(3) of the Building Code to recognize the needs of consumers and the building industry for a predictable prescriptive solution.

Sentence 12.2.1.1.(3) requires the energy efficiency design of a building or part of a building of residential occupancy within the scope of Part 9 that is intended to be occupied on a continuing basis during the winter months to comply with:

- Supplementary Standard SB-12 (Chapter 2); or
- Achieve a performance level equal to a rating of 80 or more when evaluated in accordance with the technical requirements of NRCan,"EnerGuide for New Houses: Administrative and Technical Procedures", January 2005.

Sentence 12.2.1.2.(3) which applies after December 31, 2016 requires the energy efficiency design of a building or part of a building of residential occupancy within the scope of Part 9 that is intended to be occupied on a continuing basis during the winter months to comply with:

- Supplementary Standard SB-12 (Chapter 3); or
- Achieve an energy efficiency performance level that exceeds the energy efficiency requirements of Sentence 12.2.1.1.(3) of the Building Code by 15%.

This Supplementary Standard provides prescriptive and performance compliance design options for construction for which a permit is applied for either before January 1, 2017 or after December 31, 2016. The prescriptive and performance options specifically prescribed in this Supplementary Standard, unless otherwise specified, do not require blower door testing to demonstrate compliance.

This Supplementary Standard also recognizes Energy Star as a viable design option for meeting the energy efficiency requirements of the Building Code.

This Supplementary Standard does not require labeling to demonstrate compliance with the Building Code.

1 Unless otherwise indicated, all Building Code references in this foreword refer to provisions located in Division B of the Building Code.

SUMMARY OF THE CONTENTS OF SB-12

Chapter 1: General

This Chapter sets out the scope and application of this Supplementary Standard.

Chapter 2: Acceptable Solutions for Achieving Energy Efficiency Compliance Before January 1, 2017.

This Chapter contains acceptable solutions for achieving energy efficiency compliance with Clause 12.2.1.1.(3)(b) of Division B of the Building Code and applies to construction for which a permit has been applied for before January 1, 2017. Conformance with one of the prescriptive compliance packages in Subsection 2.1.1., the performance compliance method in Subsection 2.1.2. or Energy Star requirements as specified in Subsection 2.1.3. of this Supplementary Standard will achieve an energy efficiency performance level that is intended to meet or exceed, on a systemic basis, the level that would be met by model analogues evaluated against the EnerGuide Rating System.

Chapter 3: Acceptable Solutions for Achieving Energy Efficiency Compliance After December 31, 2016.

This Chapter contains sample acceptable solutions for achieving energy efficiency compliance with Clause 12.2.1.2.(3)(b) of Division B of the Building Code and applies to construction of buildings for which a permit has been applied for after December 31, 2016. Conformance with one of the prescriptive compliance packages in Subsection 3.1.1., the performance compliance method in Subsection 3.1.2. or Energy Star requirements as specified in Subsection 3.1.3. of this Supplementary Standard is intended to achieve, on a systemic basis, an energy efficiency performance level that exceeds the energy efficiency requirements of Sentence 12.2.1.1.(3) of Division B of the Building Code by 15%.

Chapter 1

General

Section 1.1. Scope

1.1.1. Energy Efficiency Compliance

1.1.1.1. Energy Efficiency

(1) Compliance with this Supplementary Standard shall be deemed to meet the energy efficiency requirements in accordance with Sentence 12.2.1.1.(3) of Division B of the *Building Code*.

(2) The energy efficiency of existing *buildings* shall comply with
(a) Part 10 of Division B of the *Building Code* with respect to change of use, or
(b) Part 11 of Division B of the *Building Code* for renovation.

1.1.1.2. Compliance Options Before January 1, 2017

(1) The energy efficiency of a *building* or part of a building of *residential occupancy* that is within the scope of Part 9 of Division B of the *Building Code* and is intended for occupancy on a continuing basis during the winter months shall comply with
(a) Subsection 2.1.1. (Prescriptive Compliance Packages) of Chapter 2,
(b) Subsection 2.1.2. (Performance Compliance) of Chapter 2, or
(c) Subsection 2.1.3. (Other Acceptable Compliance Methods) of Chapter 2.

(2) Factory built modular homes manufactured before January 1, 2012 in accordance with the *Building Code* as it read on December 31, 2011 shall be deemed to be in compliance with Sentence (1).

1.1.1.3. Compliance Options After December 31, 2016

(1) The energy efficiency of a *building* or part of a *building* of *residential occupancy* that is within the scope of Part 9 of Division B of the *Building Code* and is intended for occupancy on a continuing basis during the winter months shall comply with
(a) Subsection 3.1.1. (Prescriptive Compliance Packages) of Chapter 3,
(b) Subsection 3.1.2. (Performance Compliance) of Chapter 3, or
(c) Subsection 3.1.3. (Other Acceptable Compliance Methods) of Chapter 3.

Section 1.2. Application

1.2.1. Application of Supplementary Standard SB-12

1.2.1.1. Energy Efficiency Design

(1) The energy efficiency of a *building* or part of a *building* of *residential occupancy* that is within the scope of Part 9 of Division B of the *Building Code* and is intended for occupancy on a continuing basis during the winter months shall comply with this Supplementary Standard in accordance with Subsection 12.2.1. of Division B of the *Building Code.*

Section 1.3. Terms and Abbreviations

1.3.1. Definitions of Words and Phrases

1.3.1.1. Non-Defined Terms

(1) Definitions of words and phrases used in this Supplementary Standard that are not included in the list of definitions in Articles 1.4.1.2. and 1.4.1.3. of Division A of the *Building Code* and are not defined in another provision of the Code shall have the meanings that are commonly assigned to them in the context in which they are used, taking into account the specialized use of terms by the various trades and professions to which the terminology applies.

1.3.1.2. Defined Terms

(1) Each of the words and terms in italics in this Supplementary Standard has the same meaning as in subsection 1(1) of the *Building Code Act, 1992* or Clause 1.4.1.2.(1)(b) of Division A of the *Building Code*.

1.3.2. Symbols and Other Abbreviations

1.3.2.1. Symbols and Other Abbreviations

(1) Where used in this Supplementary Standard, a symbol or abbreviation listed in Column 2 of Table 1.4.2.1. of Division A of the *Building Code* shall have the meaning listed opposite it in Column 3.

(2) The abbreviations listed in Column 2 of Table 1.3.2.1. shall also apply to this Supplementary Standard and shall have the meaning listed opposite it in Column 3.

Table 1.3.2.1.
Abbreviations
Forming Part of Sentence 1.3.2.1.(2)

Item	Abbreviation	Meaning
1	AFUE	annual fuel utilization efficiency
2	EF	energy factor
3	HRV	heat recovery ventilator
4	ICF	insulating concrete form
Column 1	2	3

Section 1.4. Referenced Documents and Organizations

1.4.1. Referenced Documents

1.4.1.1. Effective Date

(1) Except as provided in Sentence (2), and unless otherwise specified in this Supplementary Standard, the documents referenced in this Supplementary Standard shall include all amendments, revisions and supplements effective to October 31, 2011.

(2) All references to NRCan, "EnerGuide for New Houses: Administrative and Technical Procedures" in the *Building Code* shall be the 2005 edition with all amendments, revisions and supplements effective to May 31, 2006.

1.4.1.2. Applicable Editions

(1) Where documents are referenced in this Supplementary Standard, they shall be the editions designated in Column 2 of Table 1.4.1.2.

Table 1.4.1.2.
Referenced Documents
Forming Part of Sentence 1.4.1.2.(1)

Issuing Agency	Document Number	Title of Document	Supplementary Standard Reference
CSA	CAN/CSA-A440.2-09	Fenestration Energy Performance Evaluation of Windows and Sliding Glass Doors	2.1.1.8.(2); 3.1.1.8.(2)
CSA	B55.1-12	Test Method for Measuring Efficiency and Pressure Loss of Drain Water Heat Recovery Units	2.1.1.11.(3)
CSA	B55.2-12	Drain Water Heat Recovery Units	2.1.1.11.(2)
NFRC	NFRC 100-2010	Procedure for Determining Fenestration Product U-factors	2.1.1.8.(2); 3.1.1.8.(2)
NFRC	NFRC 200-2010	Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence	2.1.1.8.(2); 3.1.1.8.(2)
NRCan	NRCan January 2011	Energy Star for New Homes: Technical Specifications – Ontario	2.1.3.1.(1)
NRCan	NRCan January 2012	Energy Star for New Homes Standard Version 12.1	3.1.3.1.(1)
Column 1	2	3	4

Notes to Table 1.4.1.2.:
(1) NFRC refers to the National Fenestration Rating Council. (See Appendix A.)

1.4.2. Abbreviations

1.4.2.1. Abbreviations of Proper Names

(1) Where used in this Supplementary Standard, abbreviations of proper names listed in Column 1 of Table 1.3.2.1. of Division B of the *Building Code* shall have the meaning assigned opposite it in Column 2.

Chapter 2

Acceptable Solutions for Energy Efficiency Compliance Before January 1, 2017

(Applies to construction for which a permit has been applied for before January 1, 2017)

Section 2.1. Methods for Achieving Energy Efficiency Compliance

2.1.1. Prescriptive Compliance Packages (See Appendix A.)

2.1.1.1. Energy Efficiency

(1) Except as permitted in Articles 2.1.1.5. to 2.1.1.10., the minimum thermal performance and energy efficiency of *building* envelope and space heating equipment, domestic hot water heating equipment and heat recovery ventilator equipment shall conform to

(a) Article 2.1.1.2. if the *building* is located in Zone 1 with less than 5000 heating degree days, or

(b) Article 2.1.1.3. if the *building* is located in Zone 2 with 5000 or more heating degree days.

(2) All walls, ceilings, floors, windows and doors that separate heated space from unheated space, the exterior air or the exterior *soil* shall have thermal resistance ratings conforming to this Subsection.

(3) Where specified in compliance packages in Tables 2.1.1.2.A, 2.1.1.2.B and 2.1.1.2.C and Tables 2.1.1.3.A, 2.1.1.3.B and 2.1.1.3.C, space heating equipment, domestic hot water heating equipment and heat recovery ventilators shall have the efficiency rating conforming to this Subsection. (See Appendix A.)

(4) Insulation shall be provided between heated and unheated spaces and between heated spaces and the exterior in accordance with this Chapter.

(5) Reflective surfaces of insulating materials shall not be considered in calculating the thermal resistance of *building* assemblies.

(6) Where glass block is used in a wall, the required minimum overall performance of the *building* envelope shall be maintained by increasing thermal performance of other components sufficient to compensate for the additional heat loss through the glass block.

(7) Except as provided in Sentence (8) and except as permitted in Sentences (9) and 2.1.1.10.(3), where the ratio of the gross area of windows, sidelights, skylights, glazing in doors and sliding glass doors to the gross area of peripheral walls measured from grade to the top of the upper most ceiling is not more than 17%, the *building* shall comply with a compliance package selected from Tables 2.1.1.2.A, 2.1.1.2.B and 2.1.1.2.C and Tables 2.1.1.3.A, 2.1.1.3.B and 2.1.1.3.C. (See Appendix A.)

(8) Except as permitted in Sentences (9) and 2.1.1.10.(3), where the ratio of the gross area of windows, sidelights, skylights, glazing in doors and sliding glass doors to the gross area of peripheral walls measured from grade to the top of the upper most ceiling is more than 17% but not more than 22%, the *building* shall comply with a compliance package selected from Tables 2.1.1.2.A, 2.1.1.2.B and 2.1.1.2.C and Tables 2.1.1.3.A, 2.1.1.3.B and 2.1.1.3.C, and the overall coefficient of heat transfer of the glazing shall be upgraded to

(a) 1.8 where the selected compliance package requires 2.0,
(b) 1.6 where the selected compliance package requires 1.8, and
(c) 1.4 where the selected compliance package requires 1.6.
(See Appendix A.)

(9) Glazing in main entrance doors and adjacent sidelights to main entrance doors need not be calculated for the purposes of Sentences (7), (8) and (10).

(10) Except as provided in Sentences (9) and 2.1.1.10.(3), where the ratio of gross area of windows, sidelights, skylights, glazing in doors and sliding glass doors to the gross area of peripheral walls measured from grade to the top of the upper most ceiling is more than 22%, the *building* shall comply with Subsection 2.1.2. (See Appendix A.)

(11) Where a *dwelling* unit has a walkout *basement*, the thermal performance level of the exterior *basement* wall shall be not less than that required for the above grade wall for
(a) the *basement* wall containing the door opening, and
(b) any *basement* wall that has an exposed wall area above the ground level exceeding 50% of that *basement* wall area.

(12) The minimum thermal resistance of insulation shall conform to the applicable values specified in Articles 2.1.1.2. and 2.1.1.3.

(13) The minimum annual fuel utilization efficiency of a natural gas- or propane-fired furnace serving a *building* of *residential occupancy* shall conform to Table 2.1.1.1.A.

Table 2.1.1.1.A.
Furnace Minimum Annual Fuel Utilization Efficiency
Forming Part of Sentence 2.1.1.1.(13)

Furnace Fuel Source	Minimum AFUE
Natural gas	90%
Propane	90%
Column 1	2

(14) Where space heating is supplied by a solid fuel-burning *appliance* or an earth energy system, the compliance package is permitted to comply with Tables 2.1.1.2.A. and 2.1.1.3.A.

(15) Where an enclosed unheated space is separated from a heated space by glazing, the unheated enclosure may be considered to provide a thermal resistance of RSI 0.16.

(16) Where space heating equipment and domestic hot water heating equipment efficiencies are specified in a compliance package in Tables 2.1.1.2.A, 2.1.1.2.B and 2.1.1.2.C and Tables 2.1.1.3.A, 2.1.1.3.B and 2.1.1.3.C, the equipment efficiencies shall be determined in accordance with test procedures regulated by an applicable Ontario Regulation, or in the absence of such regulation, determined in accordance with test procedures governed by the applicable equipment standard.

(17) Where heat recovery ventilators are specified in a compliance package in Tables 2.1.1.2.A, 2.1.1.2.B and 2.1.1.2.C and Tables 2.1.1.3.A, 2.1.1.3.B and 2.1.1.3.C, they shall
(a) meet the requirements of Article 9.32.3.11. of Division B of the *Building Code*, and
(b) meet the minimum efficiency rating required in this Chapter based on a test temperature of 0°C at an air flow rate equal to the principle exhaust flow but need not exceed 30 L/s.

2.1.1.2. Energy Efficiency for Buildings Located in Zone 1

(1) Except as required in Sentences (2) to (4) and permitted in Sentences (5) to (11), the minimum thermal performance of *building* envelope and equipment shall conform to Table 2.1.1.2.A.

(2) Except for solid fuel-burning space heating equipment and natural gas and propane furnaces, where the space heating equipment efficiency ranges from 78% to less than 90%, the minimum thermal performance of the *building* envelope and equipment shall conform to Table 2.1.1.2.B.

(3) Where *electric space heating* is used, the minimum thermal performance of the *building* envelope and equipment shall conform to Table 2.1.1.2.C.

(4) Except for solid fuel-burning space heating equipment, where the space heating equipment efficiency is less than 78% or it cannot meet the requirements of the applicable compliance packages, energy efficiency compliance shall be achieved in accordance with Clause 12.2.1.1.(3)(a) of Division B of the *Building Code* or Subsection 2.1.2. of this Supplementary Standard.

(5) Where the thermal performance of above grade walls, windows or *basement* walls is reduced by applying Sentences (6) through (11), only the thermal performance of one of those *building* components is permitted to be reduced.

(6) Except as permitted in Sentence (7), where compliance package I or J in Table 2.1.1.2.A is used, the minimum RSI value for thermal insulation in exposed above grade walls is permitted to be not less than RSI 3.52 provided that
(a) the overall coefficient of heat transfer of the glazing is upgraded in accordance with Sentence 2.1.1.1.(8), in addition to a upgrade where it is required due to high fenestration to wall ratio, or (See Appendix A.)
(b) the thermal insulation value in *basement* walls has a minimum RSI 3.52 where compliance package J is used.

(7) Where blown-in insulation or spray-applied foam insulation is used in compliance package I or J in Table 2.1.1.2.A, the minimum RSI value for thermal insulation in exposed above grade walls is permitted to be not less than RSI 3.52 provided that
(a) the thermal insulation value in a ceiling with an attic space is not less than RSI 10.55,
(b) the minimum efficiency of the HRV is increased by not less than 8 percentage points,
(c) the minimum AFUE of the space heating equipment is increased by not less than 2 percentage points,
(d) the minimum EF of the domestic hot water heater is increased by not less than 4 percentage points, or
(e) the *building* is in compliance with Sentence (6).

(8) Except as permitted in Sentence (9), where compliance package D, E, F, G, H or M in Table 2.1.1.2.A is used, the minimum RSI value for thermal insulation of exposed above grade walls is permitted to be not less than RSI 3.52 provided that
(a) the overall coefficient of heat transfer of the glazing is upgraded in accordance with Sentence 2.1.1.1.(8), in addition to an upgrade where it is required due to high fenestration to wall ratio, and the minimum EF of the domestic hot water heater is increased by not less than 8 percentage points, or (See Appendix A.)
(b) the thermal insulation value in *basement* walls has a minimum RSI 3.52 where compliance package F, G, or H is used, and the *building* is in compliance with at least two requirements of Clauses (7)(a) to (d).

(9) Where blown-in insulation or spray-applied foam insulation is used in compliance package D, E, F, G, H or M in Table 2.1.1.2.A, the minimum RSI value for thermal insulation in exposed above grade walls is permitted to be not less than RSI 3.52 provided that
(a) the overall coefficient of heat transfer of the glazing is upgraded in accordance with Sentence 2.1.1.1.(8), in addition to an upgrade where it is required due to high fenestration to wall ratio or the thermal insulation value in *basement* walls has a minimum RSI 3.52 where compliance package F, G, or H is used, and (See Appendix A.)
(b) the *building* is in compliance with Clause (7)(a), (b), (c) or (d).

(10) Where a drain water heat recovery unit conforming to Article 2.1.1.11. is provided in addition to the requirements of a compliance package selected from Tables 2.1.1.2.A to 2.1.1.2.C.

(a) the thermal insulation value in exposed above grade walls is permitted to be not less than RSI 3.52 where it is required to be RSI 3.87,

(b) the thermal insulation value in exposed above grade walls is permitted to be not less than RSI 3.52 where it is required to be RSI 4.23, provided that the drain water heat recovery unit has a minimum efficiency of not less than 46%,

(c) the thermal insulation value in *basement* walls is permitted to be not less than RSI 2.11 where it is required to be RSI 3.52,

(d) the overall coefficient of heat transfer of glazing is permitted to be not greater than 1.8 $W/(m^2 \bullet K)$ where it is required to be 1.6 $W/(m^2 \bullet K)$, or not greater than 1.6 $W/(m^2 \bullet K)$ where it is required to be 1.4 $W/(m^2 \bullet K)$,

(e) the minimum efficiency of an HRV is permitted to be not less than 55% where it is required to be 75% or less, or

(f) the minimum efficiency of a furnace is permitted to be not less than 90% where it is required to be 94%.

(11) Where an HRV is only required for the purpose of meeting the energy efficiency requirements of a compliance package included in Table 2.1.1.2.A, the HRV may be omitted provided that a drain water heat recovery unit with a minimum efficiency of not less than 62% is installed in conformance with Article 2.1.1.11.

Table 2.1.1.2.A
ZONE 1 - Compliance Packages for Space Heating Equipment with AFUE ≥ 90%
Forming Part of Sentence 2.1.1.2.(1)

Component	Compliance Package												
	A	B	C	D	E	F	G	H	I	J	K(3)	L(4)	M(5)
Ceiling with Attic Space Minimum RSI (R)-Value(1)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	4.23 (R24)	4.75 (R27)	4.75 (R27)	4.23 (R24)	4.23 (R24)	4.23 (R24)	4.23 (R24)	4.23 (R24)	3.87 (R22)	3.87 (R22)	3.87 (R22)	4.23 (R24)	4.23 (R24)
Basement Walls Minimum RSI (R)-Value(1)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	2.11 (R12)	2.11 (R12)	2.11 (R12)	3.52 (R20)	2.11 (R12)	3.87 (R22)	3.87 (R22)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	0.88 (R5)	—	—	—	—	—	—	—	—	—	—	—	—
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.6	1.6	1.8	1.8	1.8	1.8	1.8	2.0	1.8	1.8	1.8	1.8	1.8
Skylights Maximum U-Value(2)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	90%	90%	94%	94%	90%	94%	92%	94%	92%	94%	90%	94%	90%(7)
HRV(6) Minimum Efficiency	—	—	—	—	55%	60%	60%	70%	55%	60%	—	—	—
Domestic Hot Water Heater Minimum EF	0.57	0.57	0.62	0.67	0.57	0.57	0.62	0.67	0.62	0.67	0.57	0.57	0.80(7)
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14

Notes to Table 2.1.1.2.A:

(1) Except for notes (3) and (4), the values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m² • K)/W.

(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m² • K). See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

(3) Compliance package K applies only to a building with both ICF basement walls and ICF above grade walls. Alternatively, any other compliance package is permitted to be used for a building with both ICF basement walls and ICF above grade walls. The thermal resistance value of an ICF wall is the total thermal resistance of the entire wall assembly.

(4) Compliance package L applies only to a building with ICF basement walls. Alternatively, any other compliance package except compliance package K, is permitted to be used for a building with ICF basement walls. The thermal resistance value of an ICF wall is the total thermal resistance of the entire wall assembly.

(5) Applies to a building with combined space heating and domestic hot water heating system.

(6) Except as required in Subsection 9.32.3. of Division B of the Building Code, an HRV is only required as a part of a compliance package where a minimum efficiency level is specified.

(7) Only the hot water heating equipment shall meet the minimum AFUE or EF specified in the Table or shall be of the condensing type.

Table 2.1.1.2.B
ZONE 1 - Compliance Packages for Space Heating Equipment with AFUE ≥ 78% and < 90%
Forming Part of Sentence 2.1.1.2.(2)

Component	Compliance Package					
	A	B	C	D	E	F
Ceiling with Attic Space Minimum RSI (R)-Value(1)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	5.11 (R29)	5.11 (R29)	5.11 (R29)	4.75 (R27)	4.75 (R27)	4.75 (R27)
Basement Walls Minimum RSI (R)-Value(1)	3.52 (R20)	2.11 (R12)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	—	—	—	—	—	—
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.6	1.6	1.8	1.6	1.6	1.8
Skylights Maximum U-Value(2)	2.8	2.8	2.8	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	78%	84%	84%	84%	78%	84%
HRV Minimum Efficiency	55%	55%	70%	55%	70%	75%
Domestic Hot Water Heater Minimum EF	—	—	—	—	—	—
Column 1	2	3	4	5	6	7

Notes to Table 2.1.1.2.B:

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in $(m^2 \cdot K)/W$.

(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in $W/(m^2 \cdot K)$. See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

Table 2.1.1.2.C
ZONE 1 - Compliance Packages for Electric Space Heating
Forming Part of Sentence 2.1.1.2.(3)

Component	Compliance Package	
	A	B
Ceiling with Attic Space Minimum RSI (R)-Value(1)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	5.11 (R29)	5.11 (R29)
Basement Walls Minimum RSI (R)-Value(1)	3.52 (R20)	2.11 (R12)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	—	—
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.6	1.6
Skylights Maximum U-Value(2)	2.8	2.8
Space Heating Equipment Minimum AFUE	—	—
HRV Minimum Efficiency	55%	75%
Domestic Hot Water Heater Minimum EF	—	—
Column 1	2	3

Notes to Table 2.1.1.2.C:

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in $(m^2 \cdot K)/W$.

(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in $W/(m^2 \cdot K)$. See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

2.1.1.3. Energy Efficiency for Buildings Located in Zone 2

(1) Except as required in Sentences (2) to (4) and permitted in Sentences (5) to (8), the minimum thermal performance of the *building* envelope and equipment shall conform to Table 2.1.1.3.A.

(2) Except for solid fuel-burning space heating equipment and natural gas and propane furnaces, where the space heating equipment efficiency ranges from 78% to less than 90%, the minimum thermal performance of *building* envelope and equipment shall conform to Table 2.1.1.3.B.

(3) Where *electric space heating* is used, the minimum thermal performance of the *building* envelope and equipment shall conform to Table 2.1.1.3.C.

(4) Except for solid fuel-burning space heating equipment, where the space heating equipment efficiency is less than 78% or it cannot meet the requirements of the applicable compliance packages, energy efficiency compliance shall be achieved in accordance with Clause 12.2.1.1.(3)(a) of Division B of the *Building Code* or Subsection 2.1.2. of this Supplementary Standard.

(5) Where the thermal performance of above grade walls, windows or *basement* walls is reduced by applying Sentences (6) through (8), only the thermal performance of one of those *building* components is permitted to be reduced.

(6) Except as permitted in Sentence (7), where compliance package H, I, J or M in Table 2.1.1.3.A is used, the minimum RSI value for thermal insulation of exposed above grade walls is permitted to be not less than RSI 3.52 provided that
(a) the overall coefficient of heat transfer of the glazing is upgraded in accordance with Sentence 2.1.1.1.(8), in addition to a upgrade where it is required due to high fenestration to wall ratio and the minimum EF of the domestic hot water heater is increased by not less than 8 percentage points, or (See Appendix A.)
(b) the thermal insulation value in *basement* walls has a minimum RSI 3.52 where compliance package J is used, and the *building* is in compliance with at least two requirements of Clauses 2.1.1.2.(7)(a) to (d).

(7) Where blown-in insulation or spray-applied foam insulation is used in compliance package H, I, J or M in Table 2.1.1.3.A, the minimum RSI value for thermal insulation in exposed above grade walls is permitted to be not less than RSI 3.52 provided that
(a) the overall coefficient of heat transfer of the glazing is upgraded in accordance with Sentence 2.1.1.1.(8), in addition to a upgrade where it is required due to high fenestration to wall ratio or the thermal insulation value in *basement* walls has a minimum RSI 3.52 where compliance package J is used, and (See Appendix A.)
(b) the *building* is in compliance with Clause 2.1.1.2.(7)(a), (b), (c) or (d).

(8) Where a drain water heat recovery unit conforming to Article 2.1.1.11. is provided in addition to the requirements of a compliance package selected from Tables 2.1.1.3.A to 2.1.1.3.C.
(a) the thermal insulation value in exposed above grade walls is permitted to be not less than RSI 3.87 where it is required to be RSI 4.23 provided that the drain water heat recovery unit has a minimum efficiency of not less than 41%,
(b) the thermal insulation value in *basement* walls is permitted to be not less than RSI 2.11 where it is required to be RSI 3.52, provided that the drain water heat recovery unit has a minimum efficiency of not less than 46%,
(c) the overall coefficient of heat transfer of glazing is permitted to be not greater than 1.8 $W/(m^2 \cdot K)$ where it is required to be 1.6 $W/(m^2 \cdot K)$,
(d) the overall coefficient of heat transfer of glazing is permitted to be not greater than 1.6 $W/(m^2 \cdot K)$ where it is required to be 1.4 $W/(m^2 \cdot K)$, provided that the drain water heat recovery unit has a minimum efficiency of not less than 41%, or
(e) the minimum efficiency of an HRV is permitted to be not less than 55% where it is required to be 75% or less.

Table 2.1.1.3.A
ZONE 2 - Compliance Packages for Space Heating Equipment with AFUE ≥ 90%
Forming Part of Sentence 2.1.1.3.[1]

Component	Compliance Package												
	A	B	C	D	E	F	G	H	I	J	K[3]	L[4]	M[5]
Ceiling with Attic Space Minimum RSI (R)-Value[1]	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space Minimum RSI (R)-Value[1]	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value[1]	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value[1]	5.11 (R29)	5.11 (R29)	5.11 (R29)	4.75 (R27)	4.75 (R27)	4.75 (R27)	4.75 (R27)	4.23 (R24)	4.23 (R24)	4.23 (R24)	3.87 (R22)	4.23 (R24)	4.23 (R24)
Basement Walls Minimum RSI (R)-Value[1]	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	2.11 (R12)	3.52 (R20)	3.52 (R20)	2.11 (R12)	3.87 (R22)	3.87 (R22)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value[1]	0.88 (R5)	—	—	0.88 (R5)	—	—	—	0.88 (R5)	—	—	—	—	—
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value[1]	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value[1]	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value[2]	1.6	1.6	1.8	1.6	1.6	1.8	1.8	1.6	1.6	1.6	1.8	1.8	1.8
Skylights Maximum U-Value[2]	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Space-Heating Equipment Minimum AFUE	90%	94%	92%	94%	94%	94%	94%	94%	90%	94%	94%	94%	90%[7]
HRV[6] Minimum Efficiency	—	—	60%	—	—	60%	75%	—	60%	60%	—	—	55%
Domestic Hot Water Heater Minimum EF	0.57	0.57	0.57	0.57	0.67	0.57	0.62	0.67	0.57	0.67	0.57	0.67	0.80[7]
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14

Notes to Table 2.1.1.3.A:

(1) Except for notes (3) and (4), the values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m² • K)/W.

(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m² • K). See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

(3) Compliance package K applies only to a building with both ICF basement walls and ICF above grade walls. Alternatively, any other compliance package is permitted to be used for a building with both ICF basement walls and ICF above grade walls. The thermal resistance value of an ICF wall is the total thermal resistance of the entire wall assembly.

(4) Compliance package L applies only to a building with ICF basement walls. Alternatively, any other compliance package except compliance package K, is permitted to be used for a building with ICF basement walls. The thermal resistance value of an ICF wall is the total thermal resistance of the entire wall assembly.

(5) Applies to a building with combined space heating and domestic hot water heating system.

(6) Except as required in Subsection 9.32.3. of Division B of the Building Code, an HRV is only required as a part of a compliance package where a minimum efficiency level is specified.

(7) Only the hot water heating equipment shall meet the minimum AFUE or EF specified in the Table or shall be of the condensing type.

Table 2.1.1.3.B
ZONE 2 - Compliance Packages for Space Heating Equipment with AFUE ≥ 78% and < 90%
Forming Part of Sentence 2.1.1.3.(2)

Component	Compliance Package	
	A	B
Ceiling with Attic Space Minimum RSI (R)-Value(1)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	5.11 (R29)	5.11 (R29)
Basement Walls Minimum RSI (R)-Value(1)	3.52 (R20)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	0.88 (R5)	0.88 (R5)
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm below grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.6	1.6
Skylights Maximum U-Value(2)	2.8	2.8
Space Heating Equipment Minimum AFUE	78%	84%
HRV Minimum Efficiency	75%	60%
Domestic Hot Water Heater Minimum EF	—	—
Column 1	2	3

Notes to Table 2.1.1.3.B.:

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m^2 • K)/W.

(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m^2 • K). See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

Table 2.1.1.3.C
ZONE 2 - Compliance Packages for Electric Space Heating
Forming Part of Sentence 2.1.1.3.(3)

Component	Compliance Package A
Ceiling with Attic Space Minimum RSI (R)-Value(1)	8.81 (R50)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	5.11 (R29)
Basement Walls Minimum RSI (R)-Value(1)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	0.88 (R5)
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.6
Skylights Maximum U-Value(2)	2.8
Space Heating Equipment Minimum AFUE	—
HRV Minimum Efficiency	75%
Domestic Hot Water Heater Minimum EF	—
Column 1	2

Notes to Table 2.1.1.3.C:

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in $(m^2 \cdot K)/W$.

(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in $W/(m^2 \cdot K)$. See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

2.1.1.4. Elements Acting as a Thermal Bridge

(1) Except for a *foundation* wall, the insulated portion of a wall that incorporates wood stud framing elements that have a thermal resistance of less than RSI 0.90 shall be insulated to restrict heat flow through the studs by a material providing a thermal resistance at least equal to 25% of the thermal resistance required for the insulated portion of the assembly in Articles 2.1.1.2., 2.1.1.3. and 2.1.1.10.

(2) Except as provided in Sentence (3), the thermal resistance of the insulated portion of a *building* assembly in Articles 2.1.1.2. and 2.1.1.3. that incorporates metal framing elements, such as steel studs and steel joists, that act as thermal bridges to facilitate heat flow through the assembly, shall be 20% greater than the values shown in Tables 2.1.1.2.A, 2.1.1.2.B and 2.1.1.2.C and Tables 2.1.1.3.A, 2.1.1.3.B and 2.1.1.3.C and Table 2.1.1.10., unless it can be shown that the heat flow is not greater than the heat flow through a wood frame assembly of the same thickness.

(3) Sentence (2) does not apply to *building* assemblies incorporating thermal bridges where the thermal bridges are insulated to restrict heat flow through the thermal bridges by a material providing a thermal resistance at least equal to 25% of the thermal resistance required for the insulated portion of the assembly in Articles 2.1.1.2., 2.1.1.3. and 2.1.1.10.

2.1.1.5. Log Wall Construction and Post, Beam and Plank Construction

(1) Except as provided in Sentences (2) and (3), log wall construction and post, beam and plank construction shall have a minimum thermal resistance of RSI 2.1 for the total assembly.

(2) The thermal resistance value in Sentence (1) for the total wall assembly may be reduced to not less than RSI 1.61 if,
(a) the thermal resistance of insulation for the exposed roof or ceiling required in Table 2.1.1.2.A. is increased by an amount equivalent to the reduction permitted in this Sentence, and
(b) for log walls, the logs have tongue-and-groove or splined joints.

(3) Where milled log walls are installed, the thermal resistance value in Sentence (1) for the total wall assembly does not apply if,
(a) the mean thickness of each log is not less than 150 mm,
(b) the thermal resistance of insulation for the exposed roof or ceiling required in Table 2.1.1.2.A is increased by RSI 0.53, and
(c) the logs have tongue-and-groove or splined joints.

(4) Where a log wall is constructed in accordance with Sentences (1) to (3), the log wall shall be deemed to comply with the requirements in Subsection 9.25.3. of Division B of the *Building Code*.

2.1.1.6. Insulation of Foundation Walls

(1) *Foundation* walls enclosing heated space shall be insulated from the underside of the subfloor to not more than 200 mm above the finished floor level of the *basement*. (See Appendix A.)

(2) The insulation required by Sentence (1) may be provided by a system installed,
(a) on the interior of the *foundation* wall,
(b) on the exterior face of the *foundation* wall, or
(c) partially on the interior and partially on the exterior, provided the thermal performance of the system is equivalent to that permitted in Clauses (a) or (b).

(3) If a *foundation* wall is constructed of hollow masonry units, one or more of the following shall be used to control convection currents in the core spaces,
(a) filling the core spaces,
(b) at least one row of semi-solid blocks at or below *grade*, or
(c) other similar methods.

(4) Masonry walls of hollow units that penetrate the ceiling shall be sealed at or near the ceiling adjacent to the roof space to prevent air within the voids from entering the *attic or roof space* by,
(a) capping with masonry units without voids, or
(b) installation of flashing material extending across the full width of the masonry.

(5) Except as provided in Sentences (6) and (7), where a portion of a *basement* slab or a portion of a *basement* slab edge is the only part of the slab that is at the exterior ground level such as a walk-out *basement*, or within 600 mm of the exterior ground level, those portions shall have perimeter insulation extend not less than 600 mm below the slab level. (See Appendix A.)

(6) Where the entire concrete slab is within 600 mm of the exterior ground level, the entire surface of the slab shall be insulated. (See Appendix A.)

(7) Where a slab contains heating ducts, pipes, tubes or cables, the entire heated surface of the slab that is in contact with the ground shall be insulated.

2.1.1.7. Thermal Resistance Values for Roof Access Hatches and Eaves

(1) The thermal resistance values for insulation required by Articles 2.1.1.2. and 2.1.1.3. for exposed ceilings with attic spaces are permitted to be reduced
(a) directly above access hatches, and
(b) near eaves to the extent made necessary by the roof slope and required ventilation clearances,

except that the thermal insulation value at the location directly above access hatches and inner surfaces of exterior walls shall be not less than RSI 3.52.

2.1.1.8. Thermal Performance of Windows, Skylights and Sliding Glass Doors

(1) Except as provided in Sentence (3) and except for sidelights to main entrance doors, windows, skylights and sliding glass doors shall meet
(a) the required overall coefficient of heat transfer in Tables 2.1.1.2.A, 2.1.1.2.B and 2.1.1.2.C and Tables 2.1.1.3.A, 2.1.1.3.B and 2.1.1.3.C and Table 2.1.1.10., or
(b) the corresponding energy rating in Table 2.1.1.8.

Table 2.1.1.8.
Maximum U-Values and Minimum Energy Ratings (ER) for Windows, Skylights and Sliding Glass Doors
Forming Part of Sentence 2.1.1.8.(1)

Component	Maximum U-Values	Minimum Energy Ratings, ER)
	U-Value, W/m²• K (Btu/h • ft² • °F)	ER
Skylights	2.8 (0.50)	—
Windows and Sliding Glass Doors	2.0 (0.35)	17
	1.8 (0.32)	21
	1.6 (0.28)	25
	1.4 (0.25)	29
Column 1	2	3

(2) The energy rating and the overall coefficient of heat transfer required for windows and sliding glass doors in a *residential occupancy* shall be determined in conformance with
(a) CAN/CSA-A440.2, "Fenestration Energy Performance", or
(b) NFRC 100, "Procedure for Determining Fenestration Product U-factors" and NFRC 200, "Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence".

(3) A *basement* window that incorporates a *loadbearing* structural frame shall be double glazed with a low-E coating.

2.1.1.9. Minimum Thermal Resistance of Doors

(1) Except for doors in enclosed unheated vestibules and cold cellars, and except for glazed portions of doors, all doors that separate heated space from unheated space shall have a thermal resistance of not less than RSI 0.7 where a storm door is not provided.

2.1.1.10. Additions to Existing Buildings

(1) Except as provided in Sentences (2) and (3), an addition to an existing *building* shall comply with
(a) one of the applicable compliance packages in Article 2.1.1.2. or 2.1.1.3. in accordance with this Subsection, or
(b) Sentences 2.1.1.1.(7) to (10), except that the Tables referenced in Sentences 2.1.1.1.(7) and (8) are permitted to be substituted with Table 2.1.1.10.
(See Appendix A.)

(2) For the purpose of Sentences 2.1.1.1.(7) to (10) and Subsection 2.1.2., the addition may be considered independently or in combination with the existing *building*, regardless of the thermal characteristics of the existing *building* envelope.
(See Appendix A.)

(3) A *one-storey* sunroom addition to an existing *building* shall be deemed to be in compliance with Articles 2.1.1.2. and 2.1.1.3. and Subsection 2.1.2., provided that the overall coefficient of heat transfer of
(a) doors, windows and walls has a maximum U-Value of
  (i) 1.6 if the *building* is located in Zone 1 with less than 5000 heating degree days,
  (ii) 1.4 if the *building* is located in Zone 2 with 5000 or more heating degree days, or
  (iii) 1.4 if the *building* uses *electric space heating*, and
(b) roofs and skylights has a maximum U-Value of 2.6.
(See Appendix A.)

Table 2.1.1.10.
Thermal Performance Requirements for Additions to Existing Buildings[3]
Forming Part of Sentence 2.1.1.10.(2)

Component	Zone 1 Less than 5000 Degree-Days	Zone 2 5000 or more Degree-Days	Electric Space Heating Zones 1 and 2
Ceiling with Attic Space Minimum RSI (R)-Value[1]	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling Without Attic Space Minimum RSI (R)-Value[1]	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value[1]	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value[1]	4.23 (R24)	4.23 (R24)	5.46 (R31)
Basement Walls Minimum RSI (R)-Value[1]	3.52 (R20)	3.52 (R20)	3.52 (R20)
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value[1]	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value[1]	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value[2]	1.8	1.6	1.6
Skylights Maximum U-Value[2]	2.8	2.8	2.8
Column 1	2	3	4

Notes to Table 2.1.1.10.:

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in $(m^2 \cdot K)/W$.

(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in $W/(m^2 \cdot K)$. See exceptions and use of alternative Energy Ratings (ER) in Article 2.1.1.8.

(3) The building need not conform to minimum efficiency requirements for HRV's, domestic hot water heaters and space heating equipment required in Article 2.1.1.2. or 2.1.1.3.

2.1.1.11. Drain Water Heat Recovery

(1) Where a drain water heat recovery unit is installed to meet the requirements of this Subsection, the unit and its installation shall conform to Sentences (2) to (5).

(2) Drain water heat recovery units shall conform to CSA B55.2, "Drain Water Heat Recovery Units".

(3) The minimum efficiency of a drain water heat recovery unit shall be determined in conformance with CSA B55.1, "Test Method for Measuring Efficiency and Pressure Loss of Drain Water Heat Recovery Units".

(4) A drain water heat recovery unit shall be installed
(a) to receive drain water from all showers or at least two showers where there are two or more showers in a *dwelling unit*, (See Appendix A.)
(b) in an upright position that does not diverge more than 5 degrees from the vertical,
(c) in a position such that the cold water inlet connection is at the bottom of the unit,
(d) downstream of a water softener where a water softener is installed, and
(e) in a *conditioned space* or on the warm side of the dewpoint of the wall assembly.

(5) Except as required in Clauses 2.1.1.2.(10)(b) and 2.1.1.3.(8)(a), (b) and (d), and Sentence 2.1.1.2.(11), the minimum efficiency of the drain water heat recovery unit shall be not less than 36% when it is tested in accordance with Sentence (3).

2.1.2. Performance Compliance

2.1.2.1. Required Performance Level (See Appendix A.)

(1) The performance level shall be measured based on the simulated annual energy use of the *building*.

(2) The simulated annual energy use of the proposed *building* shall not be greater than the simulated annual energy use of the *building* as if it met the performance level of a permitted compliance package in Subsection 2.1.1. selected on the basis of
(a) Zone location,
(b) energy source, and
(c) equipment efficiency.

(3) The simulated annual energy use shall be calculated for the
(a) proposed *building*, and
(b) *building* conforming to the applicable compliance package.

(4) For the purpose of calculations required in Sentence (3),
(a) a recognized annual energy use simulation software shall be used to calculate annual energy use,
(b) local climatic data shall be used, and
(c) the equivalent domestic hot water, appliance and other plug-in loads shall be assumed in both calculations.

(5) Except as provided in Sentence (6), for the purpose of Clauses (3)(a) and (3)(b), the air leakage rate of a *dwelling unit* may be assumed to be
(a) 2.5 air changes per hour at an air pressure differential of 50 Pa for detached homes, and
(b) 3.0 air changes per hour at an air pressure differential of 50 Pa for attached homes.

(6) For the purpose of Clause (3)(a), values less than Sentence (5) may be used provided that the values are verified with air leakage tests as conducted in accordance with the requirements of Clause 12.2.1.(3)(a) of Division B of the *Building Code*.

(7) For the purpose of calculations required in Clause (3)(b), the *building* shall have identical dimensions and orientation as the proposed design, except where the glazing to wall ratio exceeds 22%, the glazing area shall be reduced proportionally along each exposure until the limit is met.

(8) For the purpose of calculations required in Clause (3)(b), where frame construction is used, the design of the framing system shall assume a spacing of
(a) 406 mm o.c. for wall studs,
(b) 406 mm o.c. for exposed floors joists, roof joists and roof rafters, and
(c) 610 mm o.c. for roof trusses.

(9) For the purpose of calculations required in Clause (3)(b), *building* envelope component properties and characteristics not specifically described in this Subsection and Subsection 2.1.1. shall be modeled the same for both the proposed design and a design based on a permitted compliance package unless it can be shown such properties and characteristics of the proposed design constitute additional energy conservation measures.

(10) Where the overall thermal performance of the proposed *building* envelope is less than the envelope performance of the compliance package that is compared against it, the reduction in the performance level of the *building* envelope shall not be more than 25%.

2.1.3. Other Acceptable Compliance Methods

2.1.3.1. Other Acceptable Compliance Methods (See Appendix A.)

(1) A *building* shall be deemed to be in compliance with the requirements of Subsection 2.1.1. provided that the building is in compliance with the technical requirements of NRCan, "Energy Star for New Homes: Technical Specifications - Ontario".

Chapter 3

Acceptable Solutions for Energy Efficiency Compliance After December 31, 2016

(Applies to construction for which a permit has been applied for after December 31, 2016)

Section 3.1. Methods for Achieving Energy Efficiency Compliance

3.1.1. Prescriptive Compliance Packages (See Appendix A.)

3.1.1.1. Energy Efficiency

(1) Except as permitted in Articles 3.1.1.5. to 3.1.1.10., the minimum thermal performance and energy efficiency of *building* envelope and space heating equipment, domestic hot water heating equipment and heat recovery ventilators equipment shall conform to
(a) Article 3.1.1.2. if the *building* is located in Zone 1 with less than 5000 heating degree days, or
(b) Article 3.1.1.3. if the *building* is located in Zone 2 with 5000 or more heating degree days.

(2) All walls, ceilings, floors, windows and doors that separate heated space from unheated space, the exterior air or the exterior *soil* shall have thermal resistance ratings conforming to this Subsection.

(3) Where specified in compliance packages in Tables 3.1.1.2.A and 3.1.1.2.BC and Tables 3.1.1.3.A and 3.1.1.3.BC, space heating equipment, domestic hot water heating equipment and heat recovery ventilators shall have the efficiency rating conforming to this Subsection. (See Appendix A.)

(4) Insulation shall be provided between heated and unheated spaces and between heated spaces and the exterior in accordance with this Chapter.

(5) Reflective surfaces of insulating materials shall not be considered in calculating the thermal resistance of building assemblies.

(6) Where glass block is used in a wall, the required minimum overall performance of the *building* envelope shall be maintained by increasing thermal performance of other components sufficient to compensate for the additional heat loss through the glass block.

(7) Except as provided in Sentence (8) and except as permitted in Sentences (9) and 3.1.1.10.(3), where the ratio of the gross area of windows, sidelights, skylights, glazing in doors and sliding glass doors to the gross area of peripheral walls measured from grade to the top of the upper most ceiling is not more than 17%, the *building* shall comply with a compliance package selected from Tables 3.1.1.2.A and 3.1.1.2.BC and Tables 3.1.1.3.A and 3.1.1.3.BC. (See Appendix A.)

(8) Except as permitted in Sentences (9) and 3.1.1.10.(3), where the ratio of the gross area of windows, sidelights, skylights, glazing in doors and sliding glass doors to the gross area of peripheral walls measured from grade to the top of the upper most ceiling is more than 17% but not more than 22%, the *building* shall comply with a compliance package selected from Tables 3.1.1.2.A and 3.1.1.2.BC and Tables 3.1.1.3.A and 3.1.1.3.BC, and the overall coefficient of heat transfer of the glazing shall be upgraded to
(a) 1.8 where the selected compliance package requires 2.0,
(b) 1.6 where the selected compliance package requires 1.8,
(c) 1.4 where the selected compliance package requires 1.6, and
(d) 1.2 where the selected compliance package requires 1.4.
(See Appendix A.)

(9) Glazing in main entrance doors and adjacent sidelights to main entrance doors need not be calculated for the purposes of Sentences (7), (8) and (10).

(10) Except as provided in Sentence (9), where the ratio of gross area of windows, sidelights, skylights, glazing in doors and sliding glass doors to the gross area of peripheral walls measured from grade to the top of the upper most ceiling is more than 22%, the *building* shall comply with Subsection 3.1.2. (See Appendix A.)

(11) Where a *dwelling unit* has a walkout *basement*, the thermal performance level of the exterior *basement* wall shall be not less than that required for the above grade wall for
(a) the *basement* wall containing the door opening, and
(b) any *basement* wall that has an exposed wall area above the ground level exceeding 50% of that basement wall area.

(12) The minimum thermal resistance of insulation shall conform to the applicable values specified in Articles 3.1.1.2. and 3.1.1.3.

(13) Every *dwelling unit* that is within the scope of Part 9 and is intended for occupancy on a continuing basis during the winter months shall be equipped with a heat recovery ventilator.

(14) Where space heating is supplied by a solid fuel-burning *appliance* or an earth energy system, the compliance package is permitted to comply with Tables 3.1.1.2.A. and 3.1.1.3.A.

(15) Where an enclosed unheated space is separated from a heated space by glazing, the unheated enclosure may be considered to provide a thermal resistance of RSI 0.16.

(16) Where space heating equipment and domestic hot water heating equipment efficiencies are specified in a compliance package in Tables 3.1.1.2.A and 3.1.1.2.BC and Tables 3.1.1.3.A and 3.1.1.3.BC, the equipment efficiencies shall be determined in accordance with test procedures regulated by an applicable Ontario Regulation, or in the absence of such regulation, determined in accordance with test procedures governed by the applicable equipment standard.

(17) Where heat recovery ventilators are specified in a compliance package in Tables 3.1.1.2.A and 3.1.1.2.BC and Tables 3.1.1.3.A and 3.1.1.3.BC, they shall
(a) meet the requirements of Article 9.32.3.11. of Division B of the *Building Code*, and
(b) meet the minimum efficiency rating required in this Chapter based on a test temperature of 0°C at an air flow rate equal to the principle exhaust flow but need not exceed 30 L/s.

3.1.1.2. Energy Efficiency for Buildings Located in Zone 1

(1) Except as required in Sentences (2) and (3) and permitted in Sentence (4), the minimum thermal performance of *building* envelope and equipment shall conform to Table 3.1.1.2.A.

Table 3.1.1.2.A
ZONE 1 - Compliance Packages for Space Heating Equipment with AFUE ≥ 90%
Forming Part of Sentence 3.1.1.2.(1)

Component	Compliance Package				
	A	B	C	D	E
Ceiling with Attic Space Minimum RSI (R)-Value(1)	10.56 (R60)	10.56 (R60)	10.56 (R60)	10.56 (R60)	10.56 (R60)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	3.34 + 1.32 ci (R19 + R7.5 ci)	3.87 (R22)	3.34 + 0.88 ci (R19 + R5 ci)	4.22 (R24)	3.34 + 0.88 ci (R19 + R5 ci)
Basement Walls Minimum RSI (R)-Value(1)	3.52 + 1.40 ci (R20 + R8 ci)	3.52 (R20)	3.52 + 1.40 ci (R20 + R8 ci)	3.52 + 1.40 ci (R20 + R8 ci)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	—	—	—	—	—
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.6	1.8	1.6	1.6	1.6
Skylights Maximum U-Value(2)	2.8	2.8	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	90%	96%	94%	96%	92%
HRV Minimum Efficiency	55%	75%	75%	75%	60%
Domestic Hot Water Heater Minimum EF	0.67	0.83	0.67	0.67	0.83
Column 1	2	3	4	5	6

Notes to Table 3.1.1.2.A:
The following definitions apply: ci = continuous insulation

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in $(m^2 \cdot K)/W$.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in $W/(m^2 \cdot K)$. See exceptions and use of alternative Energy Ratings (ER) in Article 3.1.1.8.

(2) Except as permitted in Sentence (4), where the space heating equipment efficiency is less than 90% or where *electric space heating* is used, the minimum thermal performance of the *building* envelope and equipment shall conform to Table 3.1.1.2.BC.

Table 3.1.1.2.BC
ZONE 1 - Compliance Packages for Space Heating Equipment with AFUE < 90% or for Electric Space Heating
Forming Part of Sentence 3.1.1.2.(2)

Component	Compliance Package		
	A	B	C
Ceiling with Attic Space Minimum RSI (R)-Value(1)	10.56 + HH (R60 + HH)	10.56 + HH (R60 + HH)	10.56 + HH (R60 + HH)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	3.34 + 1.76 ci (R19 + R10 ci)	3.87 + 1.76 ci (R22 + R10 ci)	3.34 + 1.76 ci (R19 + R10 ci)
Basement Walls Minimum RSI (R)-Value(1)	3.52 (R20)	3.52 + 1.40 ci (R20 + R8 ci)	3.52 + 1.40 ci (R20 + R8 ci)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	—
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.4	1.6	1.4
Skylights Maximum U-Value(2)	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	—	—	—
HRV Minimum Efficiency	80%	70%	75%
Domestic Hot Water Heater Minimum EF	—	—	—
Column 1	2	3	4

Notes to Table 3.1.1.2.BC:
The following definitions apply: ci = continuous insulation HH = 250 mm high heel

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in ($m^2 \cdot K$)/W.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/($m^2 \cdot K$). See exceptions and use of alternative Energy Ratings (ER) in Article 3.1.1.8.

(3) Except as permitted in Sentence (4), where the space heating equipment efficiency cannot meet the requirements of the applicable compliance packages, energy efficiency compliance shall be achieved in accordance with Clause 12.2.1.2.(3)(a) of Division B of the *Building Code* or Subsection 3.1.2. of this Supplementary Standard.

(4) Where space heating is supplied by a solid fuel-burning appliance or an earth energy system, the compliance package is permitted to comply with Table 3.1.1.2.A.

3.1.1.3. Energy Efficiency for Buildings Located in Zone 2

(1) Except as required in Sentences (2) and (3) and permitted in Sentence (4), the minimum thermal performance of the *building* envelope and equipment shall conform to Table 3.1.1.3.A.

(2) Except as permitted in Sentence (4), where the space heating equipment efficiency is less than 90% or where *electric space heating* is used, the minimum thermal performance of the *building* envelope and equipment shall conform to Table 3.1.1.3.BC.

(3) Except as permitted in Sentence (4), where the space heating equipment efficiency cannot meet the requirements of the applicable compliance packages, energy efficiency compliance shall be achieved in accordance with Clause 12.2.1.2.(3)(a) of Division B of the *Building Code* or Subsection 3.1.2. of this Supplementary Standard.

(4) Where space heating is supplied by a solid fuel-burning appliance or an earth energy system, the compliance package is permitted to comply with Table 3.1.1.3.A.

Table 3.1.1.3.A
ZONE 2 - Compliance Packages for Space Heating Equipment with AFUE ≥ 90%
Forming Part of Sentence 3.1.1.3.(1)

Component	Compliance Package				
	A	B	C	D	E
Ceiling with Attic Space Minimum RSI (R)-Value(1)	10.56 (R60)	10.56 (R60)	10.56 (R60)	10.56 (R60)	10.56 (R60)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	3.34 + 1.32 ci (R19 + R7.5 ci)	3.34 + 0.88 ci (R19 + R5 ci)	4.22 (R24)	3.34 + 1.32 ci (R19 + R7.5 ci)	3.34 + 1.76 ci (R19 + R10 ci)
Basement Walls Minimum RSI (R)-Value(1)	3.52 + 1.40 ci (R20 + R8 ci)	3.52 + 1.40 ci (R20 + R8 ci)	3.52 + 1.40 ci (R20 + R8 ci)	3.52 (R20)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	0.88 ci (R5)	0.88 ci (R5)	1.76 (R10)	—	—
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.6	1.6	1.6	1.6	1.8
Skylights Maximum U-Value(2)	2.8	2.8	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	90%	92%	94%	94%	96%
HRV Minimum Efficiency	60%	70%	70%	70%	75%
Domestic Hot Water Heater Minimum EF	0.67	0.67	0.67	0.83	0.83
Column 1	2	3	4	5	6

Notes to Table 3.1.1.3.A:
The following definitions apply: ci = continuous insulation

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in $(m^2 \cdot K)/W$.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in $W/(m^2 \cdot K)$. See exceptions and use of alternative Energy Ratings (ER) in Article 3.1.1.8.

Table 3.1.1.3.BC
ZONE 2 - Compliance Packages for Space Heating Equipment with AFUE < 90% or for Electric Space Heating
Forming Part of Sentence 3.1.1.3.(2)

Component	Compliance Package	
	A	B
Ceiling with Attic Space Minimum RSI (R)-Value(1)	10.56 + HH (R60 + HH)	10.56 + HH (R60 + HH)
Ceiling Without Attic Space Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value(1)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value(1)	3.34 + 1.76 ci (R19 + R10 ci)	3.34 + 1.76 ci (R19 + R10 ci)
Basement Walls Minimum RSI (R)-Value(1)	3.52 + 2.11 ci (R20 + R12 ci)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	0.88 (R5)
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value(1)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value(2)	1.4	1.6
Skylights Maximum U-Value(2)	2.8	2.8
Space Heating Equipment	—	ASHP: 2.0 COP
HRV Minimum Efficiency	75%	70%
Domestic Hot Water Heater Minimum EF	—	—
Column 1	2	3

Notes to Table 3.1.1.2.BC:

The following definitions apply: ci = continuous insulation; HH = 250 mm high heel; ASHP = air source heat pump; COP = Coefficient of Performance

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in $(m^2 \cdot K)/W$.

(2) U-value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in $W/(m^2 \cdot K)$. See exceptions and use of alternative Energy Ratings (ER) in Article 3.1.1.8.

3.1.1.4. Elements Acting as a Thermal Bridge

(1) Except for a *foundation* wall, the insulated portion of a wall that incorporates wood stud framing elements that have a thermal resistance of less than RSI 0.90 shall be insulated to restrict heat flow through the studs by a material providing a thermal resistance at least equal to 25% of the thermal resistance required for the insulated portion of the assembly in Articles 3.1.1.2., 3.1.1.3. and 3.1.1.10.

(2) Except as provided in Sentence (3), the thermal resistance of the insulated portion of a *building* assembly in Articles 3.1.1.2. and 3.1.1.3. that incorporates metal framing elements, such as steel studs and steel joists, that act as thermal bridges to facilitate heat flow through the assembly, shall be 20% greater than the values shown in Tables 3.1.1.2.A and 3.1.1.2.BC and Tables 3.1.1.3.A and 3.1.1.3.BC and Table 3.1.1.10., unless it can be shown that the heat flow is not greater than the heat flow through a wood frame assembly of the same thickness.

(3) Sentence (2) does not apply to *building* assemblies incorporating thermal bridges where the thermal bridges are insulated to restrict heat flow through the thermal bridges by a material providing a thermal resistance at least equal to 25% of the thermal resistance required for the insulated portion of the assembly in Articles 3.1.1.2., 3.1.1.3. and 3.1.1.10.

3.1.1.5. Log Wall Construction and Post, Beam and Plank Construction

(1) Except as provided in Sentences (2) and (3), log wall construction and post, beam and plank construction shall have a minimum thermal resistance of RSI 2.1 for the total assembly.

(2) The thermal resistance value in Sentence (1) for the total wall assembly may be reduced to not less than RSI 1.61 if,
(a) the thermal resistance of insulation for the exposed roof or ceiling required in Table 3.1.1.2.A. is increased by an amount equivalent to the reduction permitted in this Sentence, and
(b) for log walls, the logs have tongue-and-groove or splined joints.

(3) Where milled log walls are installed, the thermal resistance value in Sentence (1) for the total wall assembly does not apply if,
(a) the mean thickness of each log is not less than 150 mm,
(b) the thermal resistance of insulation for the exposed roof or ceiling required in Table 3.1.1.2.A is increased by RSI 0.53, and
(c) the logs have tongue-and-groove or splined joints.

(4) Where a log wall is constructed in accordance with Sentences (1) to (3), the log wall shall be deemed to comply with the requirements in Subsection 9.25.3. of Division B of the *Building Code*.

3.1.1.6. Insulation of Foundation Walls

(1) *Foundation* walls enclosing heated space shall be insulated from the underside of the subfloor to not more than 200 mm above the finished floor level of the *basement*. (See Appendix A.)

(2) The insulation required by Sentence (1) may be provided by a system installed,
(a) on the interior of the *foundation* wall,
(b) on the exterior face of the *foundation* wall, or
(c) partially on the interior and partially on the exterior, provided the thermal performance of the system is equivalent to that permitted in Clauses (a) or (b).

(3) If a *foundation* wall is constructed of hollow masonry units, one or more of the following shall be used to control convection currents in the core spaces,
(a) filling the core spaces,
(b) at least one row of semi-solid blocks at or below *grade*, or
(c) other similar methods.

(4) Masonry walls of hollow units that penetrate the ceiling shall be sealed at or near the ceiling adjacent to the roof space to prevent air within the voids from entering the *attic or roof space* by,
(a) capping with masonry units without voids, or
(b) installation of flashing material extending across the full width of the masonry.

(5) Except as provided in Sentences (6) and (7), where a portion of a *basement* slab or a portion of a *basement* slab edge is the only part of the slab that is at the exterior ground level such as a walk-out *basement*, or within 600 mm of the exterior ground level, those portions shall have perimeter insulation extend not less than 600 mm below the slab level. (See Appendix A.)

(6) Where the entire concrete slab is within 600 mm of the exterior ground level, the entire surface of the slab shall be insulated. (See Appendix A.)

(7) Where a slab contains heating ducts, pipes, tubes or cables, the entire heated surface of the slab that is in contact with the ground shall be insulated.

3.1.1.7. Thermal Resistance Values for Roof Access Hatches and Eaves

(1) The thermal resistance values for insulation required by Articles 3.1.1.2. and 3.1.1.3. for exposed ceilings with attic spaces are permitted to be reduced
(a) directly above access hatches, and
(b) near eaves to the extent made necessary by the roof slope and required ventilation clearances,

except that the thermal insulation value at the location directly above access hatches and inner surfaces of exterior walls shall be not less than RSI 3.52.

3.1.1.8. Thermal Performance of Windows, Skylights and Sliding Glass Doors

(1) Except as provided in Sentence (3) and except for sidelights to main entrance doors, windows, skylights and sliding glass doors shall meet
(a) the required overall coefficient of heat transfer in Tables 3.1.1.2.A and 3.1.1.2.BC and Tables 3.1.1.3.A and 3.1.1.3.BC and Table 3.1.1.10., or
(b) the corresponding energy rating in Table 3.1.1.8.

(2) The energy rating and the overall coefficient of heat transfer required for windows and sliding glass doors in a *residential occupancy* shall be determined in conformance with
(a) CAN/CSA-A440.2, "Fenestration Energy Performance", or
(b) NFRC 100, "Procedure for Determining Fenestration Product U-factors" and NFRC 200, "Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence".

(3) A *basement* window that incorporates a *loadbearing* structural frame shall be double glazed with a low-E coating.

Table 3.1.1.8.
Maximum U-Values and Minimum Energy Ratings (ER) for Windows, Skylights and Sliding Glass Doors
Forming Part of Sentence 3.1.1.8.(1)

Component	Maximum U-Values	Minimum Energy Ratings, ER)
	U-Value, $W/m^2 \cdot K$ ($Btu/h \cdot ft^2 \cdot °F$)	ER
Skylights	2.8 (0.50)	—
Windows and Sliding Glass Doors	2.0 (0.35)	17
	1.8 (0.32)	21
	1.6 (0.28)	25
	1.4 (0.25)	29
Column 1	2	3

3.1.1.9. Minimum Thermal Resistance of Doors

(1) Except for doors in enclosed unheated vestibules and cold cellars, and except for glazed portions of doors, all doors that separate heated space from unheated space shall have a thermal resistance of not less than RSI 0.7 where a storm door is not provided.

3.1.1.10. Additions to Existing Buildings

(1) Except as provided in Sentences (2) and (3), an addition to an existing *building* shall comply with
(a) one of the applicable compliance packages in Article 3.1.1.2. or 3.1.1.3. in accordance with this Subsection, or
(b) Sentences 3.1.1.1.(7) to (10), except that the Tables referenced in Sentences 3.1.1.1.(7) and (8) are permitted to be substituted with Table 3.1.1.10.
(See Appendix A.)

(2) For the purpose of Sentences 3.1.1.1.(7) to (10) and Subsection 3.1.2., the addition may be considered independently or in combination with the existing *building*, regardless of the thermal characteristics of the existing *building* envelope. (See Appendix A.)

(3) A one-*storey* sunroom addition to an existing *building* shall be deemed to be in compliance with Articles 3.1.1.2. and 3.1.1.3. and Subsection 3.1.2., provided that the overall coefficient of heat transfer of
(a) doors, windows and walls has a maximum U-Value of
  (i) 1.4 if the *building* is located in Zone 1 with less than 5000 heating degree days,
  (ii) 1.4 if the *building* is located in Zone 2 with 5000 or more heating degree days, or
  (iii) 1.2 if the *building* uses *electric space heating*, and
(b) roofs and skylights has a maximum U-Value of 2.6.
(See Appendix A.)

Table 3.1.1.10.
Thermal Performance Requirements for Additions to Existing Buildings[3]
Forming Part of Sentence 3.1.1.10.(2)

Component	Zone 1 Less than 5000 Degree-Days	Zone 2 5000 or more Degree-Days	Electric Space Heating Zones 1 and 2
Ceiling with Attic Space Minimum RSI (R)-Value[1]	10.56 + HH (R60 + HH)	10.56 + HH (R60 + HH)	10.56 + HH (R60 + HH)
Ceiling Without Attic Space Minimum RSI (R)-Value[1]	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R)-Value[1]	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R)-Value[1]	3.34 + 0.88 ci (R19 + R5 ci)	3.34 + 0.88 ci (R19 + R5 ci)	3.34 + 1.76 ci (R19 + R10 ci)
Basement Walls Minimum RSI (R)-Value[1]	3.52 + 1.40 ci (R20 + R8 ci)	3.52 + 1.40 ci (R20 + R8 ci)	3.52 + 1.76 ci (R20 + R10 ci)
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value[1]	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R)-Value[1]	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value[2]	1.6	1.6	1.4
Skylights Maximum U-Value[2]	2.8	2.8	2.8
Column 1	2	3	4

Notes to Table 3.1.1.10.:
The following definitions apply: ci = continuous insulation HH = 250 mm high heel

(1) The values listed are minimum RSI-Values for the thermal insulation component only. RSI-Values are expressed in (m² • K)/W.
(2) U-Value is the overall coefficient of heat transfer for a window assembly, sliding glass door assembly or skylight assembly expressed in W/(m² • K). See exceptions and use of alternative Energy Ratings (ER) in Article 3.1.1.8.
(3) The building need not conform to minimum efficiency requirements for HRV's, domestic hot water heaters and space heating equipment required in Article 3.1.1.2. or 3.1.1.3.

3.1.2. Performance Compliance

3.1.2.1. Required Performance Level (See Appendix A.)

(1) The performance level shall be measured based on the simulated annual energy use of the *building*.

(2) The simulated annual energy use of the proposed *building* shall not be greater than the simulated annual energy use of the *building* as if it met the performance level of a permitted compliance package in Subsection 3.1.1. selected on the basis of
(a) Zone location,
(b) energy source, and
(c) equipment efficiency.

(3) The simulated annual energy use shall be calculated for the
(a) proposed *building*, and
(b) *building* conforming to the applicable compliance package.

(4) For the purpose of calculations required in Sentence (3),
(a) a recognized annual energy use simulation software shall be used to calculate annual energy use,
(b) local climatic data shall be used, and
(c) the equivalent domestic hot water, appliance and other plug-in loads shall be assumed in both calculations.

(5) Except as provided in Sentence (6), for the purpose of Clauses (3)(a) and (3)(b), the air leakage rate of a *dwelling unit* may be assumed to be
(a) 2.5 air changes per hour at an air pressure differential of 50 Pa for detached homes, and
(b) 3.0 air changes per hour at an air pressure differential of 50 Pa for attached homes.

(6) For the purpose of Clause (3)(a), values less than Sentence (5) may be used provided that the values are verified with air leakage tests as conducted in accordance with the requirements of Clause 12.2.1.2.(3)(a) of Division B of the *Building Code*.

(7) For the purpose of calculations required in Clause (3)(b), the *building* shall have identical dimensions and orientation as the proposed design, except where the glazing to wall ratio exceeds 22%, the glazing area shall be reduced proportionally along each exposure until the limit is met.

(8) For the purpose of calculations required in Clause (3)(b), where frame construction is used, the design of the framing system shall assume a spacing of
(a) 406 mm o.c. for wall studs,
(b) 406 mm o.c. for exposed floors joists, roof joists and roof rafters, and
(c) 610 mm o.c. for roof trusses.

(9) For the purpose of calculations required in Clause (3)(b), *building* envelope component properties and characteristics not specifically described in this Subsection and Subsection 2.1.1. shall be modeled the same for both the proposed design and a design based on a permitted compliance package unless it can be shown such properties and characteristics of the proposed design constitute additional energy conservation measures.

(10) Where the overall thermal performance of the proposed *building* envelope is less than the envelope performance of the compliance package that is compared against it, the reduction in the performance level of the *building* envelope shall not be more than 25%.

3.1.3. Other Acceptable Compliance Methods

3.1.3.1. Other Acceptable Compliance Methods (See Appendix A.)

(1) A *building* shall be deemed to be in compliance with the requirements of Subsection 3.1.1. provided that the *building* is in compliance with the technical requirements of NRCan, "Energy Star for New Homes Standard Version 12.1".

Appendix A

Explanatory Material for SB-12

Chapter 1: General

A-Table 1.4.1.2. National Fenestration Rating Council.

Name	Address	Contact
NFRC	National Fenestration Rating Council 6305 Ivy Lane, Suite 140 Greenbelt, MD 20770, USA	ph: 301-589-1776 fax: 301-589-3884 web site: www.nfrc.org
Column 1	2	3

Chapter 2: Acceptable Solutions for Achieving Energy Efficiency Compliance Before January 1, 2017.

A-2.1.1. Compliance Packages.
Individual components of compliance packages found in Tables 2.1.1.2.A, 2.1.1.2.B and 2.1.1.2.C and Tables 2.1.1.3.A, 2.1.1.3.B and 2.1.1.3.C are not permitted to be mixed with similar components of other compliance packages either found within the same Table or similar components of compliance packages found in other Tables.

A-2.1.1.1.(3) Mechanical Equipment.
Compliance package tables referred to in this Sentence contain energy efficiency requirements for some or all mechanical equipment. Where a compliance package includes an energy efficiency level for space heating equipment, domestic hot water heater or heat recovery ventilator, conformance with the package can only be achieved if the building is equipped with the mechanical equipment specified in the compliance package.

A-2.1.1.1.(7), (8) and (10) Fenestration to Wall Ratio.

When the fenestration to wall ratio is calculated, all fenestration areas and the entire peripheral wall above grade is included. The peripheral wall area includes floor rim board areas and all above grade wall areas. It is essentially the sum of the above grade walls that separate conditioned spaces from unconditioned spaces, and adjacent units. In the case of an attached garage, the walls that are common with the house and the garage are also included in the wall area calculations. For attached homes, the above grade portions of the walls that are common to other conditioned units are also included in the wall area. The fenestration area is based on the rough structural opening provided for windows, skylights, sliding glass doors, and for glazed portions in doors. For A–frame structures with steeply inclined roofs that also act as walls, the roof portion that serves as the interior wall area can be considered as the wall area in calculating the fenestration to wall ratio.

A-2.1.1.2.(6)(a), (8)(a), and (9)(a) RSI Reduction of Above Grade Walls in Conjunction with Upgrading U-Value of Glazing - Zone 1.
Where the above grade wall insulation is permitted to be reduced to RSI 3.52, one of the required compensating measures is to upgrade the window U-Value in accordance with Clauses 2.1.1.1.(8)(a) to (c). This upgrade is independent of the glazing upgrade that may be required due to a fenestration ratio that is higher than 17%. In cases where the above grade insulation is reduced to RSI 3.52 and compensated for with a fenestration upgrade, and the building has more than 17% fenestration, the glazing would be required to be upgraded a second time.

A-2.1.1.3.(6)(a) and (7)(a) RSI Reduction of Above Grade Walls in Conjunction with Upgrading U-Value of Glazing - Zone 2.

Where the above grade wall insulation is permitted to be reduced to RSI 3.52, one of the required compensating measures is to upgrade the window U-Value in accordance with Clauses 2.1.1.1.(8)(a) to (c). This upgrade is independent of the glazing upgrade that may be required due to a fenestration ratio that is higher than 17%. In cases where the above grade insulation is reduced to RSI 3.52 and compensated for with a fenestration upgrade, and the building has more than 17% fenestration, the glazing would be required to be upgraded a second time.

A-2.1.1.6.(1) Permitted Basement Insulation Gap.

The provision refers to the gap between basement insulation and the floor level that might be left at the bottom of a foundation wall. Insulation can be extended from the underside of the subfloor to the floor level of the basement, or a gap may be left provided that the gap is not more than 200 mm when measured from floor level to where the insulation is terminated.

A-2.1.1.6.(5) and (6) Slab Insulation.

Except where specifically required in a compliance package, the entire surface of the slab is only required to be insulated when the entire concrete slab is completely within 600 mm of the exterior ground level. A typical example would be a slab on ground construction without a basement. If a slab is partially at the exterior ground level (i.e. a walkout basement) or partially within 600 mm of the exterior surface, then only those parts are required to be insulated with perimeter insulation.

Where a slab of a house is completely or partially within 600 mm of the exterior ground level, either the entire surface of the slab or the perimeter of the slab is required to be insulated but not at both locations.

A-2.1.1.10.(1) Additions to Existing Houses.

In Clause 2.1.1.10.(1)(a), the design and construction of an addition to an existing house can conform to the minimum building envelope and mechanical equipment requirements where an applicable compliance package is selected from Article 2.1.1.2. or 2.1.1.3.

Alternatively, Clause 2.1.1.10.(1)(b) provides a simpler approach and permits an addition to an existing building to comply with the appropriate column in Table 2.1.1.10. since the design and construction of an existing building is unlikely to be determined and matched against an applicable compliance package from Article 2.1.1.2. or 2.1.1.3. However, the addition is required to comply with Sentences 2.1.1.1.(7) to (10). Glazing upgrade of the addition is required if it falls within the scope of Sentence 2.1.1.1.(8). Table 2.1.1.10. further exempts both an addition and an existing building from conforming to minimum efficiency requirements for HRV's, domestic hot water heaters and space heating equipment required in Article 2.1.1.2. or 2.1.1.3. This would permit existing mechanical equipment to serve the entire building provided that it has the necessary capacity.

A-2.1.1.10.(2) Treatment of Additions.

Where the fenestration to wall ratio of an addition is calculated or the annual energy use of an addition is modeled for the purpose of demonstrating compliance, calculations can be done for only the addition or the for entire house including the existing part of the house. Regardless, the thermal characteristics of the existing building, existing window and wall areas can be used in the fenestration ratio calculations. Similarly, in the case of modeling, existing building components that have not been altered can be used as they are for the reference house and for the proposed design.

A-2.1.1.10.(3) Sunroom Additions to Existing Houses.

A sunroom addition to an existing house referred in this Sentence applies to a one-storey structure built substantially with wall/roof fenestration and glass doors but which sometimes contain unglazed low wall panels that support wall glazing above it. Since the glazing percentage of sunrooms exceeds the limits permitted for compliance packages in Articles 2.1.1.2. and 2.1.1.3. and performance compliance methods may not be possible, these sunrooms are exempt from compliance package requirements, provided that the thermal performance of the glazing is enhanced further than what is required for non-sunroom additions.

The maximum U-Values for doors, sliding glass doors, wall glazing and supporting wall panels for sunroom additions in Clause 2.1.1.10.(3)(a) have been derived from the maximum U-Values for window and sliding glass doors in additions to existing buildings in Table 2.1.1.10. and then upgraded in accordance with Sentence 2.1.1.1.(8).

The maximum U-Value of 2.6 for roofs and skylights for sunroom additions in Clause 2.1.1.10.(3)(b) has been derived from upgrading the maximum U-Value of 2.8 for skylights in additions to existing buildings in Table 2.1.1.10. consistent with the methodology used in Sentence 2.1.1.1.(8).

A-2.1.2.1. Application of Performance Compliance Path.

This Article requires two annual energy use simulations. These simulations compare the simulated annual energy use of the proposed building with the simulated annual energy use of an applicable compliance package. The simulated annual energy use of the proposed building cannot exceed the simulated annual energy use of an applicable compliance package.

Where a performance compliance path is selected, it is the intent of Sentence 2.1.2.1.(2) that the performance level of the compliance package takes into account the requirements listed in Subsection 2.1.1. that are applicable to that compliance package. Similarly, the annual energy use calculation for a compliance package referenced in Clause 2.1.2.1.(3)(b) shall take into account the requirements listed in Subsection 2.1.1. that are applicable to that compliance package.

For the purpose of calculating the annual energy use of a proposed design and a design based on a selected compliance package, the following software may be used:

- HOT2000 version 9.34c or newer versions
- other software referenced by the Energuide Rating System
- RESNET accredited Home Energy Rating System (HERS) software, such as:
  - OptiMiser
  - EnergyGauge
  - EnergyInsights
  - REM/Rate

A-2.1.3.1. Other Acceptable Compliance Methods.

Compliance with the technical requirements of the Energy Star Program may be achieved using either the prescriptive path or the performance path required by NRCan,"Energy Star for New Homes: Technical Specifications – Ontario".

Clause 2.1.1.1 of NRCan,"Energy Star for New Homes: Technical Specifications – Ontario" allows the designer to use an NRCan-approved compliance option described in NRCan, "Energy Star for New Homes: Compliance Options" (Ontario).

Only the technical provisions contained in NRCan,"Energy Star for New Homes: Technical Specifications – Ontario" and other Energy Star documents it references are mandatory under this Supplementary Standard. However, in addition to the technical requirements, the administrative requirements of the Energy Star documents may be used to demonstrate compliance with Sentence 2.1.3.1.(1) by obtaining an Energy Star label for the building.

Chapter 3: Acceptable Solutions for Achieving Energy Efficiency Compliance After December 31, 2016.

A-3.1.1. Compliance Packages.

Individual components of compliance packages found in Tables 3.1.1.2.A and, 3.1.1.2.BC and Tables 3.1.1.3.A and 3.1.1.3.BC are not permitted to be mixed with similar components of other compliance packages either found within the same Table or similar components of compliance packages found in other Tables.

A-3.1.1.1.(3) Mechanical Equipment.

Compliance package tables referred to in this Sentence contain energy efficiency requirements for some or all mechanical equipment. Where a compliance package includes an energy efficiency level for space heating equipment, domestic hot water heater or heat recovery ventilator, conformance with the package can only be achieved if the building is equipped with the mechanical equipment specified in the compliance package.

A-3.1.1.1.(7), (8) and (10) Fenestration to Wall Ratio.

When the fenestration to wall ratio is calculated, all fenestration areas and the entire peripheral wall above grade is included. The peripheral wall area includes floor rim board areas and all above grade wall areas. It is essentially the sum of the above grade

walls that separate conditioned spaces from unconditioned spaces, and adjacent units. In the case of an attached garage, the walls that are common with the house and the garage are also included in the wall area calculations. For attached homes, the above grade portions of the walls that are common to other conditioned units are also included in the wall area. The fenestration area is based on the rough structural opening provided for windows, skylights, sliding glass doors, and for glazed portions in doors. For A-frame structures with steeply inclined roofs that also act as walls, the roof portion that serves as the interior wall area can be considered as the wall area in calculating the fenestration to wall ratio.

A-3.1.1.6.(1) Permitted Basement Insulation Gap.

The provision refers to the gap between basement insulation and the floor level that might be left at the bottom of a foundation wall. Insulation can be extended from the underside of the subfloor to the floor level of the basement, or a gap may be left provided that the gap is not more than 200 mm when measured from floor level to where the insulation is terminated.

A-3.1.1.6.(5) and (6) Slab Insulation.

Except where specifically required in a compliance package, the entire surface of the slab is only required to be insulated when the entire concrete slab is completely within 600 mm of the exterior ground level. A typical example would be a slab on ground construction without a basement. If a slab is partially at the exterior ground level (i.e. a walkout basement) or partially within 600 mm of the exterior surface, then only those parts are required to be insulated with perimeter insulation.

Where a slab of a house is completely or partially within 600 mm of the exterior ground level, either the entire surface of the slab or the perimeter of the slab is required to be insulated but not at both locations.

A-3.1.1.10.(1) Additions to Existing Houses.

In Clause 3.1.1.10.(1)(a), the design and construction of an addition to an existing house can conform to the minimum building envelope and mechanical equipment requirements where an applicable compliance package is selected from Article 3.1.1.2. or 3.1.1.3.

Alternatively, Clause 3.1.1.10.(1)(b) provides a simpler approach and permits an addition to an existing building to comply with the appropriate column in Table 3.1.1.10. since the design and construction of an existing building is unlikely to be determined and matched against an applicable compliance package from Article 3.1.1.2. or 3.1.1.3. However, the addition is required to comply with Sentences 3.1.1.1.(7) to (10). Glazing upgrade of the addition is required if it falls within the scope of Sentence 3.1.1.1.(8). Table 3.1.1.10. further exempts both an addition and an existing building from conforming to minimum efficiency requirements for HRV's, domestic hot water heaters and space heating equipment required in Article 3.1.1.2. or 3.1.1.3. This would permit existing mechanical equipment to serve the entire building provided that it has the necessary capacity.

A-3.1.1.10.(2) Treatment of Additions.

Where the fenestration to wall ratio of an addition is calculated or the annual energy use of an addition is modeled for the purpose of demonstrating compliance, calculations can be done for only the addition or the for entire house including the existing part of the house. Regardless, the thermal characteristics of the existing building, existing window and wall areas can be used in the fenestration ratio calculations. Similarly, in the case of modeling, existing building components that have not been altered can be used as they are for the reference house and for the proposed design.

A-3.1.1.10.(3) Sunroom Additions to Existing Houses.

A sunroom addition to an existing house referred in this Sentence applies to a one-storey structure built substantially with wall/roof fenestration and glass doors but which sometimes contain unglazed low wall panels that support wall glazing above it. Since the glazing percentage of sunrooms exceeds the limits permitted for compliance packages in Articles 3.1.1.2. and 3.1.1.3. and performance compliance methods may not be possible, these sunrooms are exempt from compliance package requirements, provided that the thermal performance of the glazing is enhanced further than what is required for non-sunroom additions.

The maximum U-Values for doors, sliding glass doors, wall glazing and supporting wall panels for sunroom additions in Clause 3.1.1.10.(3)(a) have been derived from the maximum U-Values for window and sliding glass doors in additions to existing buildings in Table 3.1.1.10. and then upgraded in accordance with Sentence 3.1.1.1.(8).

The maximum U-Value of 2.6 for roofs and skylights for sunroom additions in Clause 3.1.1.10.(3)(b) has been derived from upgrading the maximum U-Value of 2.8 for skylights in additions to existing buildings in Table 3.1.1.10. consistent with the methodology used in Sentence 3.1.1.1.(8).

A-3.1.2.1. Application of Performance Compliance Path.

This Article requires two annual energy use simulations. These simulations compare the simulated annual energy use of the proposed building with the simulated annual energy use of an applicable compliance package. The simulated annual energy use of the proposed building cannot exceed the simulated annual energy use of an applicable compliance package.

Where a performance compliance path is selected, it is the intent of Sentence 3.1.2.1.(2) that the performance level of the compliance package takes into account the requirements listed in Subsection 3.1.1. that are applicable to that compliance package. Similarly, the annual energy use calculation for a compliance package referenced in Clause 3.1.2.1.(3)(b) shall take into account the requirements listed in Subsection 3.1.1. that are applicable to that compliance package.

For the purpose of calculating the annual energy use of a proposed design and a design based on a selected compliance package, the following software may be used:

- HOT2000 version 9.34c or newer versions
- other software referenced by the Energuide Rating System
- RESNET accredited Home Energy Rating System (HERS) software, such as:
  - OptiMiser
  - EnergyGauge
  - EnergyInsights
  - REM/Rate

A-3.1.3.1. Other Acceptable Compliance Methods.

Compliance with the technical requirements of the Energy Star Program may be achieved using either the prescriptive path or the performance path required by NRCan,"Energy Star for New Homes Standard Version 12.1".

Only the technical provisions contained in NRCan,"Energy Star for New Homes Standard Version 12.1" and other Energy Star documents it references are mandatory under this Supplementary Standard. However, in addition to the technical requirements, the administrative requirements of the Energy Star documents may be used to demonstrate compliance with Sentence 3.1.3.1.(1) by obtaining an Energy Star label for the building.

Appendix A

Appendix A to this document is included for explanatory purposes only and does not form part of the requirements. The bold-face reference numbers that introduce each item apply to the requirements in the Code.

Explanatory Material for Division A

A-1.1.2. Limit of Application.

The provisions in this Code are intended to establish minimum acceptable standards for public health and public safety, fire protection, structural sufficiency, conservation, environmental integrity, barrier-free use and access. They are not intended to be applied to voluntary installations unless specified in the Code.

For example, a firewall installed for insurance purposes need not comply with the requirements in Subsection 3.1.8. of Division B unless it is used as a means to create 2 buildings for the purposes of other Code requirements. Similarly, it is not intended that voluntary standpipe installations comply with the relevant requirements in Subsection 3.2.9. of Division B. Voluntary installations should not detrimentally affect features required by the Code.

A-1.1.3.1. Buildings Divided by Firewalls.

This concept relates to the provisions directly regulated by this Code and does not apply to electrical service entrance and natural gas service requirements which are regulated by other documents.

A-1.2.1.1.(1)(a) Compliance Via Acceptable Solutions.

If a building design (e.g. material, component, assembly or system) can be shown to meet all provisions of the applicable acceptable solutions in Division B (e.g. it complies with the applicable provisions of a referenced standard), it is deemed to have satisfied the objectives and functional statements linked to those provisions and thus to have complied with that part of the Code. In fact, if it can be determined that a design meets all the applicable acceptable solutions in Division B, there is no need to consult the objectives and functional statements in Division A to determine its compliance.

A-1.4.1.2.(1) Defined Terms.

Exit

Exits include doors or doorways leading directly into an exit stair or directly to the outside. In the case of an exit leading to a separate building, exits also include vestibules, walkways, bridges and balconies.

Fire Separation

A fire separation may or may not have a fire-resistance rating.

Plumbing System

"Plumbing" is defined in the *Building Code Act, 1992*. Each of the three systems (drainage, venting, water) appearing in the definition are further defined in Article 1.4.1.2., with the end result that a plumbing system encompasses all three elements. Other piping systems as listed below are excluded from plumbing system since the definition of water system limits the system to the point of juncture with outlets, fixtures, etc. Similarly, a drainage system starts at the fixture or plumbing appliance it drains.

A plumbing system does not include,

(a) a system of piping,
   (i) for space heating in which water is used as a medium to transfer heat,
   (ii) in which liquids or vapours are circulated for the purpose of cooling or refrigeration,
   (iii) through which air is passed for the purpose of controlling the temperature, humidity or motion of air passing through the system,

(iv) that conveys water for the purpose of providing water or nutrients to the soil,
(v) that conveys water for the purpose of landscaping or for the care of animals, birds or fish,
(vi) that transmits force by means of water or by means of a liquid other than water in which water is used for cooling,
(vii) that conveys liquids for the purpose of melting ice or snow, or
(viii) that uses water in the conveyance of flammable gas or fuel; or

(b) a well, a well pump installed for the purpose of conveying water from a well, a pressure tank and pump if the tank and pump are combined as a unit, the piping between any well pump and the well, the piping between a well pump and a pressure tank that is installed separate from the pump and the connection of the piping to such pressure tank, and when there is no well pump, any piping connected to the well for a distance of three feet from the outside of the well.

A-1.4.1.3. Applicable Law.

Applicants for building permits are required to establish compliance with applicable law. The following table lists contact information for those agencies responsible for the statutory provisions defined in Sentence 1.4.1.3.(1):

Applicable Law Provision	Responsible Agency	Contact
City of Toronto Act, 2006: Subsection 102 (3) of the City of Toronto Act, 2006 By-laws made under section 108 of the City of Toronto Act, 2006 but only with respect to the issuance of a permit for the construction of a green roof. Section 114 of the City of Toronto Act, 2006, with respect to the approval by the City of Toronto or the Ontario Municipal Board of plans and drawings.	City of Toronto	General Inquiry: ph: 311 or 416-392-2489
Clean Water Act, 2006: Clause 59(1)(b) of the Clean Water Act, 2006 with respect to the issuance of a notice by the risk management official for the construction of a building.	Ministry of Environment	General Inquiry: ph: 416-325-4000 or 800-565-4923
Conservation Authorities Act: Clause 28(1)(c) under the Conservation Authorities Act, with respect to the permission of the authority for the construction of a building if the control of flooding, erosion, dynamic beaches or pollution may be affected by the development.	Local Conservation Authority	
Development Charges Act, 1997: Sections 28 and 53 under the Development Charges Act, 1997.	Local Municipality	
Environmental Assessment Act: Section 5 of the Environmental Assessment Act, with respect to the approval of the Ministry or the Environmental Review Tribunal to proceed with an undertaking. Subsection 5(4) of the Environmental Assessment Act	Ministry of the Environment	General Inquiry: ph: 416-325-4000 or 800-565-4923 Environmental Approvals Branch ph: 416-314-8001 or 800-461-6290

Applicable Law Provision	Responsible Agency	Contact
Environmental Protection Act: Section 46 of the Environmental Protection Act with respect to the approval of the Minister to use land or land covered by water that has been used for the disposal of waste. Section 47.3 of the Environmental Protection Act, with respect to the issuance of a renewable energy approval. Section 168.3.1 of the Environmental Protection Act, with respect to the construction of a building to be used in connection with a change of use of a property. Paragraph 2 of Subsection 168.6(1) of the Environmental Protection Act, if a certificate of property use has been issued in respect of the property under subsection 168.6(1) of the Act.	Ministry of the Environment	General Inquiry: ph: 416-325-4000 or 800-565-4923 Central Region ph: 416-326-6700 or 800-810-8048 Eastern Region ph: 613-549-4000 or 800-267-0974 Northern Region ph: 807-475-1205 or 800-875-7772 Southwestern Region ph: 519-873-5000 or 800-265-7672 West Central Region ph: 905-521-7640 or 800-668-4557
Municipal Act, 2001 Subsection 133(4) of the Municipal Act, 2001.	Local Municipality	
Ontario Planning and Development Act, 1994, Section 14 Ontario Planning and Development Act, 1994, with respect to any conflict between a development plan made under that Act and a zoning by-law that affects the proposed building or structure. Subsection 17(1) Ontario Planning and Development Act, 1994 with respect to orders made under that Act.	Ministry of Municipal Affairs and Housing	General Inquiry: ph: 416-585-7041 Central Municipal Services Office ph: 416-585-6226 or 800-668-0230 Eastern Municipal Services Office ph: 613-545-2100 or 800-267-9438 Northeastern Municipal Services Office ph: 705-564-0120 or 800-461-1193 Northwestern Municipal Services Office ph: 807-475-1651 or 800-465-5027 Southwestern Municipal Services Office ph: 519-873-4020 or 800-265-4736

Applicable Law Provision	Responsible Agency	Contact
Planning Act: Section 33 of the Planning Act, except where in the case of demolition of a residential property, a permit to demolish the property is obtained under that Section By-laws made under Sections 34 or 38 of the Planning Act. Section 41 of the Planning Act, with respect to the approval by the council of the municipality of the Municipal Board of plans and drawings. Section 42 of the Planning Act, with respect to the payment of money to the Municipality. Section 46 of the Planning Act. By-laws made under O. Reg. 608/06 (Development Permits) made under the Planning Act. By-laws made under O. Reg. 246/01 (Development Permits) made under the Planning Act.	Local Municipality	
Planning Act: Section 47 of the Planning Act, with respect to orders made under that Act.	Ministry of Municipal Affairs and Housing	General Inquiry: ph: 416-585-7041 Central Municipal Services Office ph: 416-585-6226 or 800-668-0230 Eastern Municipal Services Office ph: 613-545-2100 or 800-267-9438 Northeastern Municipal Services Office ph: 705-564-0120 or 800-461-1193 Northwestern Municipal Services Office ph: 807-475-1651 or 800-465-5027 Southwestern Municipal Services Office ph: 519-873-4020 or 800-265-4736

A-1.5.1.1.(1) Application of Referenced Documents.

Documents referenced in the Building Code may contain provisions covering a wide range of issues, including issues that are unrelated to the objectives and functional statements stated in Parts 2 and 3 of Division A respectively; e.g. aesthetic issues such as colour-fastness or uniformity. Sentence 1.5.1.1.(1) is intended to make it clear that, whereas referencing a document in the Building Code generally has the effect of making the provisions of that document part of the Code, provisions that are unrelated to buildings or to the objectives and functional statements attributed to the provisions in Division B where the document is referenced are excluded.

Furthermore, many documents referenced in the Building Code contain references to other documents, which may also, in turn, refer to other documents. These secondary and tertiary referenced documents may contain provisions that are unrelated to buildings or to the objectives and functional statements of the Building Code: such provisions - no matter how far down the chain of references they occur - are not included in the intent of Sentence 1.5.1.1.(1) of Division A.

Explanatory Material for Division B

A-1.1.2.1.(2) Winter Design Temperatures.

The 2.5 percent values referenced in Sentence 1.1.2.1.(2) are the least restrictive temperatures that can be used. If a designer chooses to use the 1 percent values shown in MMAH Supplementary Standard SB-1, they would be in excess of the Code minimums and would be considered acceptable.

A-1.3.2.1. Abbreviations of Proper Names.

The following table provides contact information for organizations referenced in this Code:

Name	Address	Contact
ACGIH	American Conference of Governmental Industrial Hygienists 1330 Kemper Meadow Drive Cincinnati, Ohio 45240 USA	ph: 513-742-2020 fax: 513-742-3355 web site: www.acgih.org
AISI	American Iron and Steel Institute 25 Massachusetts Ave., NW Suite 800 Washington, DC 20001 USA	ph: 202-452-7100 fax: 202-452-1039 web site: www.steel.org
ANSI	American National Standards Institute 25 West 43rd Street, 4th Floor New York, New York 10036 USA	ph: 212-642-4900 fax: 212-398-0023 web site: www.ansi.org
APHA	American Public Health Association 800 I Street, NW Washington, DC 20001 USA	ph: 202-777-2742 fax: 202-777-2534 web site: www.apha.org
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, Georgia 30329 USA	ph: 404-636-8400 800-527-4723 fax: 404-321-5478 web site: www.ashrae.org
ASME	The American Society of Mechanical Engineers Three Park Avenue New York, New York 10016-5990 USA	ph: 800-843-2763 fax: 973-882-1717 web site: www.asme.org
ASPE	American Society of Plumbing Engineers 6400 Shafer Court, Suite 350 Rosemont, Illinois 60018 USA	ph: 847-296-0002 fax: 847-296-2963 web site: www.aspe.org
ASSE	American Society of Sanitary Engineering 901 Canterbury Suite A Westlake, Ohio 44145 USA	ph: 440-835-3040 fax: 440-835-3488 web site: www.asse-plumbing.org

Name	Address	Contact
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive PO Box C700 West Conshohocken, Pennsylvania 19428-2959 USA	ph: 610-832-9585 fax: 610-832-9555 web site: www.astm.org
AWPA	American Wood-Preservers' Association P.O. Box 361784 Birmingham, Alabama 35236-1784 USA	ph: 205-733-4077 fax: 205-733-4075 web site: www.awpa.com
AWS	American Welding Society 8669 NW 36th Street, Suite 130 Doral, Florida 33166 USA	ph: 800-443-9353 fax: 305- 443-5647 web site: www.aws.org
AWWA	American Water Works Association 6666 W. Quincy Ave. Denver, Colorado 80235 USA	ph: 303-794-7711 800-926-7337 fax: 303-347-0804 web site: www.awwa.org
BCMOHS	British Columbia Ministry of Health Population Health and Wellness, Health Protection 1515 Blanshard Street, 4th Floor Victoria, British Columbia V8W 3C8	ph: (250) 952-1469 fax: (250) 952-1713 web site: http://www.health.gov.bc.ca
BNQ	Bureau de Normalisation du Québec 333, rue Franquet Québec, Québec G1P 4C7	ph: 418-652-2238 800-386-5114 fax: 418-652-2292 web site: www.bnq.qc.ca
CCBFC	Canadian Commission on Building and Fire Codes National Research Council Canada Building M-23A 1200 Montreal Road Ottawa, Ontario K1A 0R6	ph: 613-993-9960 fax: 613-952-4040 web site: www.nationalcodes.ca
CGSB	Canadian General Standards Board 11 Laurier Street Gatineau, Quebec K1A 1G6	ph: 819-956-0425 800-665-2472 fax: 819-956-5740 web site: www.pwgsc.gc.ca/cgsb
CSA	Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, Ontario L4W 5N6	ph: 416-747-4044 800-463-6727 fax: 416-747-2510 web site: www.csa.ca
CWC	Canadian Wood Council 99 Bank Street, Suite 400 Ottawa, Ontario K1P 6B9	ph: 613-747-5544 800-463-5091 fax: 613-747-6264 web site: www.cwc.ca
DBR	Institute for Research in Construction National Research Council Canada Building M-23A 1200 Montreal Road Ottawa, Ontario K1A 0R6 The Division of Building Research (DBR) is now known as the Institute for Research in Construction.	ph: 613-993-9960 fax: 613-952-4040 web site: www.nationalcodes.ca
EPA	Environmental Protection Agency Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460 USA	ph: (202) 272-0167 web site: www.epa.gov
FINA	Fédération Internationale de Natation Avenue de l'Avant-Poste No 4 CH-1005 Lausanne, Switzerland	ph: (+41-21) 310-47-10 fax: (+41-21) 312-66-10 web site: www.fina.org

Name	Address	Contact
HC	Health Canada Address Locator 0900C2 Ottawa, Ontario K1A 0K9	ph: 866-225-0709 fax: 613-941-5366 web site: www.hc-sc.gc.ca
HI	Hydronics Institute Division of GAMA 35 Russo Place P.O. Box 218 Berkeley Heights, New Jersey 07922 USA The Hydronics Institute was formally merged into GAMA in 2004.	ph: 866-408-3831 908-464-8200 fax: 908-464-7818 web site: www.gamanet.org
HRAI	Heating, Refrigerating and Air-Conditioning Institute of Canada 2800 Skymark Avenue Building 1, Suite 201 Mississauga, Ontario L4W 5A6	ph: 905-602-4700 800-267-2231 fax: 905-602-1197 web site: www.hrai.ca
HVI	Home Ventilating Institute 1000 N. Rand Rd. Suite 214 Wauconda, Illinois 60084 USA	ph: 847-526-2010 fax: 847-526-3993 web site: www.hvi.org
IESNA	Illuminating Engineering Society of North America 120 Wall Street, Floor 17 New York, New York 10005-4001 USA	ph: 212-248-5000 fax: 212-248-5017 web site: www.iesna.org
ISO	International Organization for Standardization ISO Central Secretariat 1, ch. de la Voie-Creuse CP 56 CH-1211 Geneva 20, Switzerland	ph: 41-22-749-01-11 fax: 41-22-733-34-30 web site: www.iso.org
HUD	U.S. Department of Housing and Urban Development HUD established HUD USER as the primary source of US government technical housing publications. HUD USER P.O. Box 23268 Washington, DC 20026-3268 USA	ph: 202-708-3178 800-245-2691 fax: 202-708-9981 web site: www.huduser.org
MMAH	Ministry of Municipal Affairs and Housing 777 Bay Street, 17th Floor Toronto, Ontario M5G 2E5	ph: 416-585-7041 fax: 416-585-6470 web site: www.ontario.ca/buildingcode
MOE	Ontario Ministry of the Environment 135 St Clair Avenue West Toronto, Ontario M4V 1P5	ph: 416-323-4321 fax: 416-323-4564 web site: www.ene.gov.on.ca
NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, Massachusetts 02169-7471 USA	617-770-3000 fax: 617-770-0700 web site: www.nfpa.org
NLGA	National Lumber Grades Authority #302 -960 Quayside Drive, New Westminster, British Columbia V3M 6G2	ph: 604-524-2393 fax: 604-524-2893 web site: www.nlga.org
NRCan	Natural Resources Canada Office of Energy Efficiency 580 Booth St., 18th Floor Ottawa, Ontario K1A 0E4	ph: 613-995-2943 800-387-2000 web site: www.nrcan-rncan.gc.ca
NSF	NSF International P.O. Box 130140 789 N. Dixboro Road Ann Arbor, Michigan 48113-0140 USA	ph: 734-769-8010 fax: 734-769-0109 web site: www.nsf.org
SMACNA	Sheet Metal and Air Conditioning Contractors National Association Inc. 4201 Lafayette Center Drive Chantilly, Virginia 20151-1219 USA	ph: 703-803-2980 fax: 703-803-3732 web site: www.smacna.org

Name	Address	Contact
TC	Transport Canada 330 Sparks Street Ottawa, Ontario K1A 0N5	ph: 613-990-2309 866-995-9737 fax: 613-954-4731 web site: www.tc.gc.ca
TPIC	Truss Plate Institute of Canada c/o Jager Metal Products, #220 6223 2nd Street East, Calgary, Alberta T2H 1J5 The TPIC, "Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses" is available on-line at: the TPIC web site at: www.tpic.ca.	web site: www.tpic.ca.
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, Illinois 60062-2096 USA	ph: 847-272-8800 web site: www.ul.com
ULC	Underwriters' Laboratories of Canada 7 Underwriters Road Toronto, Ontario M1R 3A9	ph: 866-937-3852 fax: 416-757-8727 web site: www.ulc.ca
USDA	United States Department of Agriculture 1400 Independence Ave., S.W. Washington, DC 20250 USA	web site: www.usda.gov
WEF	Water Environment Federation 601 Wythe Street Alexandria, Virginia 22314-1994 USA	ph: 800-666-0206 fax: 703-684-2492 web site: www.wef.org

A-3.1.9. Penetrations.

In the application of Subsection 3.1.9., a building service is considered to penetrate an assembly if it passes into or through the assembly. In some situations a service item enters an assembly through a membrane at one location, runs within the assembly, and then leaves the assembly through a membrane at another location.

The term "membrane penetration" usually designates an opening made through one side (wall, floor or ceiling membrane) of an assembly, whereas the term "through-penetration" designates an opening that passes through an entire assembly. Fire stopping of membrane penetrations involves installing a material, device or assembly to resist for a prescribed time period the passage of flame and heat through the openings in a protective membrane caused by cables, cable trays, conduit, tubing, pipes or similar items. Fire stopping of a though-penetration involves installing an assembly of specific materials or products that are designed, tested and fire-resistance rated to resist for a prescribed period of time the spread of fire through penetrations.

Products for fire stopping within a barrier are required to address movement of the assembly and to control smoke spread; as such, the flexibility of the material used at the flexible joints as well as the nature of the assembly and its potential movement must be taken into consideration.

A-3.1.9.1.(1)(b) Tightly Fitted.

The intention behind the use of the term "tightly fitted" is to reinforce that there are to be no gaps between the building service or other penetrating item and the membrane or assembly it penetrates. A typical means of fire stopping for a service or other penetration through a concrete slab or wall is "cast in place" concrete.

A-6 Crawl Spaces Used as Warm Air Plenums.

The requirements for crawl spaces used as warm air plenums have not been included in this Part. Crawl spaces may be used as warm air plenums if design measures are taken to prevent moisture, soil or radon gases from entering the crawl space and being distributed throughout the space.

A-6.2.1.3. Structural Movement.

This Article is intended to remind designers and installers of mechanical systems of one aspect of the "good engineering practice" referred to in Article 6.2.1.1. In determining how to accommodate structural movement, there are two important principles to bear in mind:

- The prime concern of the Code is the safety of people in and around the building, as opposed to protection of the mechanical systems and equipment.
- The nature of the accommodation will vary with the type of movement being considered, taking into account particularly how often the movement is likely to be encountered over the life of the building.

For example, a gas line supported on columns that also support a crane must be installed in such a way that the movement of the columns, which occurs many times daily, does not cause the lines to break, thus creating a hazard. Even if the gas line installation could somehow be designed to break in a non-hazardous manner, it would hardly be recognized as good engineering practice if movement that occurs so frequently could disrupt the operation of the mechanical system.

On the other hand, earthquakes occur far less frequently and it would not be surprising to have a non-critical mechanical system fail as a result of an earthquake. However, even in this situation, the failure must occur in a manner that does not create a hazard to building occupants. For example, heavy mechanical equipment should be properly anchored so that it does not topple on building occupants during an earthquake. The design of the anchors should take into account accelerations consistent with the seismic data given in MMAH Supplementary Standard SB-1 for the location of the building. Part 4 provides guidance on the calculation of the loads such equipment would exert on the building structure during an earthquake; these same loads can be used in designing the anchors.

Some mechanical equipment can be an important component of post-disaster life safety systems. In these cases, the measures needed to accommodate the movements caused by an earthquake become even more critical since failure of the equipment would not be acceptable. Clearly, complying with this requirement will, in most cases, necessitate close coordination between the mechanical designer and the structural designer.

A-6.2.1.8.(1) Installation - General.

Ducts or pipes without dampers or valves are generally not considered to constitute "equipment" and are therefore not subject to this requirement.

A-6.2.2.1.(2) Minimum Flow Rate of Outdoor Make-up Air.

Except for self-contained mechanical ventilation systems serving a dwelling unit, the minimum flow rate of outdoor make-up air is listed in Table 2 of the ASHRAE 62 "Ventilation for Acceptable Indoor Air Quality" Standard. These values have been chosen to control air contaminants with an adequate margin of safety and to account for health variations among people, and varied activity levels.

A-6.2.2.1.(3) Self-Contained Mechanical Ventilation Systems.

When self-contained mechanical ventilation systems are to be designed under Part 6 instead of Subsection 9.32.3., the reference to Subsection 9.32.3. for conformance is intended to ensure that the principle design objectives of Subsection 9.32.3. (including total ventilation capacity, fan ratings, energy efficiency ratings for heat recovery ventilators, etc.) are met using good engineering practice criteria found in Part 6.

A-6.2.2.4.(3) Minimizing Growth of Micro-Organisms.

Sources for microbial growth causing hypersensitivity pnuemontis and humdifier fever include drain pans, spray- water air-washers, contaminated filters, poorly maintained cooling coils, water incursion into ductwork, cafeteria dishwater drainage leaks, high humidity and stagnant water. Some of the control measures are as follows:

(a) Drain pans should be pitched toward the drain outlet and the outlet bottom should be flush with the drain pan bottom, otherwise there will be standing water in the pan, exposed to the supply air passing through the cooling section of the air-handling unit.
(b) Access into air-handling equipment should be provided for maintenance of filters, cooling coils and condensate drain pans located below the cooling coils. Access doors should be large and easy to open to facilitate thorough and regular maintenance. Hinged access doors are preferable to bolted access panels.
(c) If moisture is added to commercial building ventilation air (such as hospital operating rooms and dedicated computer rooms) to maintain humidity levels in a designated range (for example, 40% to 50% relative humidity), humidifiers that inject steam or water vapour into central air-handling units or main supply ducts are normally used. Injection nozzles should not be located in air-handling unit plenums or ductwork that is insulated with internal fibrous lining. If the lining becomes wet, conditions conducive to microbial growth will result.

The above only addresses built-in features of an HVAC system that can help to minimize growth of mirco-organisms. Even more important than the built-in features is a program of regular maintenance and cleaning of those portions of the system where such growth is likely to occur.

A-6.2.2.7.(1) Ventilation and Venting of Crawl Spaces and Attic or Roof Spaces.

Sentence 6.2.2.7.(1) requires that crawl spaces be ventilated either by natural (above-grade only) or mechanical means. High moisture levels within the crawl space can lead to problems such as the formation of mould, lifting of flooring or long-term damage to structural components. Crawl space ventilation cannot be expected to correct moisture-related problems caused by other factors like inadequate surface drainage from the foundation walls or improper protection against moisture from the ground. These conditions must be properly addressed so that crawl space ventilation can meet its intended objectives.

Several factors favour the use of mechanical ventilation rather than reliance on natural drafts. Local conditions, such as areas with high water tables, may dictate the need for mechanical ventilation to remove excessive moisture.

Crawl spaces should be maintained at a negative pressure relative to the conditioned area above to prevent the migration of moisture into occupied areas. This can be achieved through the use of an exhaust fan and relying on air transfer through floor penetrations, such as pipes.

A-6.2.4.4. Warm Air Supply Outlets.

If the heating system is designed to also distribute ventilation air, high inside wall or ceiling outlets with diffusers, and designed for such applications, may be used. In this case, low wall air-returns would be needed.

A-6.2.4.7.(3) Return Air System.

This requirement addresses radiant heat exposure directly between the heat exchanger or any other radiating parts located within the furnace cabinet, and the return air duct material. For the purposes of this Sentence, these parts do not include the furnace casing or cabinet. Clearances around the furnace casing are addressed by the Gas Installation Code and the appliance manufacturer's installation guide.

A-6.2.4.10. Clearances for Warm-Air Supply Ducts.

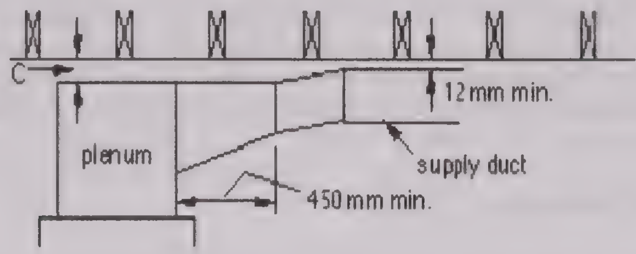


Figure A-6.2.4.10.(1)
Applicable to forced-air furnaces where permissible clearance C above plenum is 75 mm or less.

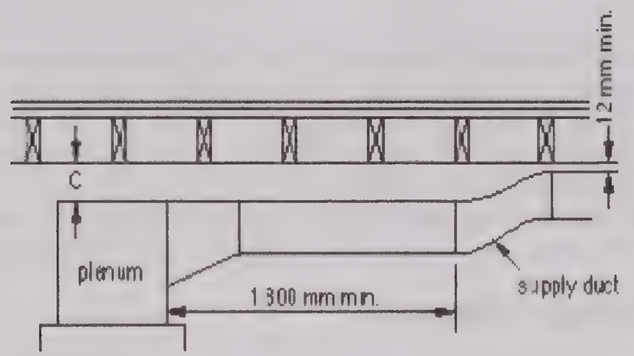


Figure A-6.2.4.10.(2)
Applicable to forced-air furnaces where permissible clearance C above plenum is more than 75 mm but not more than 150 mm.

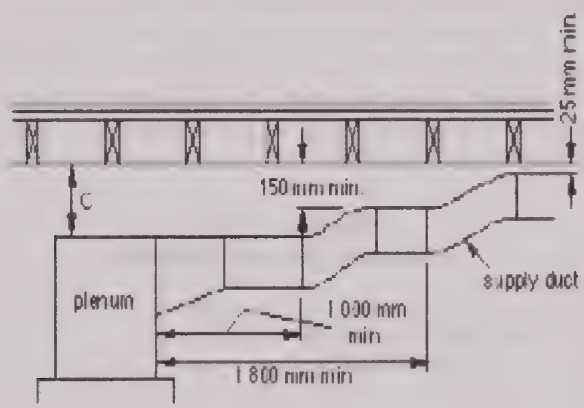


Figure A-6.2.4.10.(3)
Applicable to forced-air furnaces where permissible clearance C above plenum is more than 150 mm.

A-6.2.9.2.(6) Temperature of Exposed Piping.

Normally piping carrying steam or high-temperature hot water at pressures above atmospheric (corresponding temperature 100°C or above) will be insulated to reduce heat losses as an economy measure. Above a temperature of approximately 70°C, however, a bare pipe can cause a burn to human flesh coming in contact with the pipe. If pipes above this temperature are normally out of reach of all persons other than maintenance personnel or are properly guarded, it would be expected that no insulation would be needed for public safety.

A-9.1.1.9. Factory-Built Buildings.

Manufactured buildings intended for residential occupancy must comply with all appropriate Code requirements. Only those building components that are designed and constructed in manufacturing plants in accordance with the specified standards (CSA Z240.2.1 and CSA A277) are deemed to comply with the Code. Building components designed and constructed outside the place of manufacture (e.g. masonry chimneys, basement stairs, foundations, etc.) must conform to the requirements of the Code. The Code also applies to the site installation of manufactured buildings in terms of tie-down, spatial separation, grading, plumbing connections to street services, etc.

CSA standard CSA A277, "Procedures for Factory Certification of Buildings", describes a procedure whereby an independent certification agency can review the quality control procedures of a housing factory and make periodic, unannounced inspections of its products and thus, through suitable labelling, provide assurance to authorities at the final site that the components that cannot be inspected on site comply with the code indicated on the label. It is not a building code, only a procedure for certifying compliance of factory-built components with a building code or other standard. If a factory-built house bears the label of a creditable certification agency indicating that compliance with the National Building Code has been certified using the A277 procedure, the accepting authority will have some assurance that the hidden components do not need to be inspected again on site.

A-9.3.2.1.(1) Grade Marking of Lumber.

Lumber is generally grouped for marketing into the species combinations contained in Table A-9.3.2.1.(1)A. The maximum allowable spans for those combinations are listed in the span tables for joists, rafters and beams. Some species of lumber are also marketed individually. Since the allowable span for the northern species combination is based on the weakest species in the combination, the use of the span for this combination is permitted for any individual species not included in the Spruce-Pine-Fir, Douglas Fir-Larch and Hemlock-Fir combinations.

Facsimiles of typical grade marks of lumber associations and grading agencies accredited by the Canadian Lumber Standards (CLS) Accreditation Board to grade mark lumber in Canada are shown in Table A-9.3.2.1.(1)B. Accreditation by the CLS Accreditation Board applies to the inspection, grading and grade marking of lumber, including mill supervisory service, in accordance with CSA O141, "Softwood Lumber". The grade mark of a CLS accredited agency on a piece of lumber indicates its assigned grade, species or species combination, moisture condition at the time of surfacing, the responsible grader or mill of origin and the CLS accredited agency under whose supervision the grading and marking was done.

Table A-9.3.2.1.(1)A.
Species Designations and Abbreviations

Commercial Designation of Species or Species Combination	Abbreviation Permitted on Grade Stamps	Species Included
Douglas Fir — Larch	D Fir — L (N)	Douglas Fir, Western Larch
Hemlock — Fir	Hem — Fir (N)	Western Hemlock, Amabilis Fir
Spruce — Pine — Fir	S — P — F or Spruce — Pine — Fir	White Spruce, Engelmann Spruce, Black Spruce, Red Spruce, Lodgepole Pine, Jack Pine, Alpine Fir, Balsam Fir
Northern Species	North Species	Any Canadian softwood covered by the NLGA Standard Grading Rules

Canadian lumber is graded to the NLGA Standard Grading Rules for Canadian Lumber, published by the National Lumber Grades Authority. The NLGA rules specify standard grade names and grade name abbreviations for use in grade marks to provide positive identification of lumber grades. In a similar fashion, standard species names or standard species abbreviations, symbols or marks are provided in the rules for use in grade marks.

Grade marks denote the moisture content of lumber at the time of surfacing. "S-Dry" in the mark indicates the lumber was surfaced at a moisture content not exceeding 19%. "MC 15" indicates a moisture content not exceeding 15%. "S-GRN" in the grade mark signifies that the lumber was surfaced at a moisture content higher than 19% at a size to allow for natural shrinkage during seasoning.

Each mill or grader is assigned a permanent number. The point of origin of lumber is identified in the grade mark by use of a mill or grader number or by the mill name or abbreviation. The CLS certified agency under whose supervision the lumber was grade marked is identified in the mark by the registered symbol of the agency.

Table A-9.3.2.1.(1)B.
Facsimiles of Grade Marks Used by Canadian Lumber Manufacturing Associations and Agencies Authorized to Grade Mark Lumber in Canada

Facsimiles of Grade Mark	Association or Agency
A.F.P.A.® 00 S-P-F NLGA KD-HT 1	Alberta Forest Products Association 500—10709 Jasper Avenue Edmonton, Alberta T5J 3N3 www.albertaforestproducts.ca
CMSA® No1 KD-HT NLGA 100 S-P-F	Canadian Mill Services Association #200, 601—6th Street New Westminster, British Columbia V3L 3C1 www.canserve.org
CSI No.1 00 KD-HT NLGA D FIR-L (N)	Canadian Softwood Inspection Agency Inc. 1047—250A Street Aldergrove, British Columbia V4W 2S8
CFPA® 26 S-P-F KD-HT 2 NLGA	Central Forest Products Association Inc. c/o Reimer & Co., Chartered Accountants PO Box 146 Swan River, Manitoba R0L 1Z0
COFI® KD-HT 91 1 NLGA S-P-F ILMA® KD-HT 25 1 NLGA D FIR - L(N)	Council of Forest Industries Southern Region: 360—1855 Kirschner Road Kelowna, British Columbia V1Y 4N7 Northern Region: 400—1488 Fourth Avenue Prince George, British Columbia V2L 4Y2 www.cofi.org

Table A-9.3.2.1.(1)B. (Cont'd)
Facsimiles of Grade Marks Used by Canadian Lumber Manufacturing Associations and Agencies Authorized to Grade Mark Lumber in Canada

Facsimiles of Grade Mark	Association or Agency
5 ® NLGA No. 2 KD-HT S-P-F GGO	MacDonald Inspection Services Ltd. 842 Eland Drive Campbell River, British Columbia V9W 6Y8 www.gradestamp.com
M L® B S-P-F No.1 KD-HT 99 NLGA	Maritime Lumber Bureau PO Box 459 Amherst, Nova Scotia B4H 4A1 www.mlb.ca
N L P A® NLGA S-P-F NO.1 000 KD HT	Newfoundland and Labrador Lumber Producers Association P.O. Box 8 Glovertown, Newfoundland A0G 2L0 www3.nf.sympatico.ca/nllpa
NWT 10 CONST S-P-F S-GRN NLGA	Northwest Territories Forest Industries Association PO Box 220 Fort Smith, Northwest Territories X0E 0P0
CL®A 100 1 NLGA S-P-F KD-HT	Ontario Forest Industries Association (Home of CLA Grading and Inspection) 20 Toronto Street Suite 950 Toronto, Ontario M5C 2B8 www.ofia.com

Table A-9.3.2.1.(1)B. (Cont'd)
Facsimiles of Grade Marks Used by Canadian Lumber Manufacturing Associations and Agencies Authorized to Grade Mark Lumber in Canada

Facsimiles of Grade Mark	Association or Agency
O.L.M.A.® 09 1 KD-HT NLGA S—P—F	Ontario Lumber Manufacturers' Association PO Box 97530 Toronto, Ontario M1C 4Z1 www.olma.ca
PLIB® NO. 1 KD - HT S-P-F 00 NLGA RULES	Pacific Lumber Inspection Bureau 1010 S. 336th Street Suite 300 Federal Way, Washington 98003 USA British Columbia Division: P.O. Box 19118 Fourth Avenue Postal Outlet Vancouver, British Columbia V6C 4R8 www.plib.org
® S-P-F KD-HT 1 477 NLGA	Quebec Lumber Manufacturers' Association (Conseil de l'industrie forestière du Québec) 1175, avenue Lavigerie Bureau 200 Sainte Foy, Québec G1V 4P1 www.qfic.gc.ca

A-Table 9.3.2.1. Lumber Grading.

To identify board grades the paragraph number of the NLGA rules under which the lumber is graded must be shown in the grade mark. Paragraph 113 is equivalent to WWPA rules and paragraph 114 is equivalent to WCLIB rules. When graded in accordance with WWPA or WCLIB rules, the grade mark will not contain a paragraph number.

A-9.3.2.8.(1) Non-Standard Lumber.

The NLGA "Standard Grading Rules for Canadian Lumber" permit lumber to be dressed to sizes below the standard sizes (38 x 89 mm (2" x 4"), 38 x 140 mm (2" x 6"), 38 x 184 mm (2" x 8"), etc.) provided the grade stamp shows the reduced size. This Sentence permits the use of the span tables for such lumber, provided the size indicated on the stamp is not less than 95% of the corresponding standard size. Allowable spans in the tables must be reduced a full 5% even if the undersize is less than the 5% permitted.

A.9.3.2.9.(3) Protection of Structural Wood Elements from Moisture and Decay.

There are many above-ground, structural wood systems where precipitation is readily trapped or drying is slow, creating conditions conducive to decay. Some examples of elements that can accumulate water when exposed to precipitation if they are not detailed to allow drainage are:

- beams extending beyond roof decks
- junctions between deck members
- connections between balcony guards and walls.

A-9.3.2.9.(4) Protection of Retaining Walls and Cribbing from Decay.

Retaining walls supporting soil are considered to be structural elements of the building if a line drawn from the outer edge of the footing to the bottom of the exposed face of the retaining wall is greater than 45° to the horizontal. Retaining walls supporting soil may be structural elements of the building if the line described above has a lower slope.

Retaining walls that are not critical to the support of building foundations but are greater than 1.2 m in height may pose a danger of sudden collapse to persons adjacent to the wall if the wood is not adequately protected from decay. The height of the retaining wall or cribbing is measured as the vertical difference between the ground levels on each side of the wall.

A-9.4.1.1. Structural Design.

Article 9.4.1.l. establishes the principle that the structural members of Part 9 buildings must

- comply with the prescriptive requirements provided in Part 9,
- be designed in accordance with accepted good practice, or
- be designed in accordance with Part 4 using the loads and limits on deflection and vibration specified in Part 9 or Part 4.

Usually a combination of approaches is used. For example, even if the snow load calculation on a wood roof truss is based on Subsections 9.4.2., the joints must be designed in accordance with Part 4. Wall framing may comply with the prescriptive requirements in Subsections 9.23.3., 9.23.10., 9.23.11. and 9.23.12., while the floor framing may be engineered.

Design according to Part 4 or accepted good engineering practice, such as that described in the "Engineering Guide for Wood Frame Construction" (CWC Guide), published by the Canadian Wood Council, requires engineering expertise. The CWC Guide contains alternative solutions and provides information on the applicability of the Part 9 prescriptive structural requirements to further assist designers and building officials to identify the appropriate design approach. The need for professional involvement in the structural design of a building, whether to Part 4 or Part 9 requirements or accepted good practice, is defined by provincial legislation and is reflected in Section 1.2. of Division C.

A-9.4.1.1.(3) Structural Design for Lateral Wind and Earthquake Loads.

The only explicit treatment of structural loads in Section 9.4. is for gravity loads; wind and earthquake loads are dealt with implicitly in the body of Part 9 and are not used as inputs to any of the span tables. There may therefore be a tendency to assume that wind and earthquake loads do not need to be considered in the design of Part 9 buildings. In most cases this is true: the majority of low rise, wood frame buildings have a great deal of structural redundancy and continuity and have more than enough capacity to resist lateral loads due to wind and earthquake.

For example, in a traditional house configuration, even if there are large openings in the exterior walls for picture windows and sliding doors, the many interior partitions act as shear walls and provide adequate lateral stability. This may not be the case for some newer house designs.

However, this does not apply to all building configurations or details that might be found in Part 9 buildings. For example, a mercantile building might be long and narrow with almost entirely windowed walls on the ends and few structurally attached interior partitions. See Figure A-9.4.1.1.(3)A. In such a case, wind and earthquake loads would have to be considered in the design of the long structural walls and their foundations.

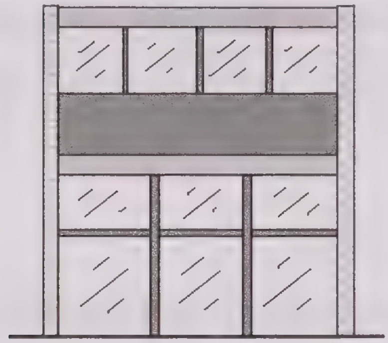


Figure A-9.4.1.1.(3)A
Mercantile Building with Little Resistance to Lateral Loading

Many buildings have been constructed with the lowest level exterior walls as short, wood-frame knee- or pony-walls. In the past, these were often constructed with no lateral bracing and with no interior partitions. The only structural continuity in the foundation-to-knee-wall and knee-wall- to-floor joints comes from nailing and this is inadequate to resist lateral loads from significant earthquakes. See Figure A-9.4.1.1.(3)B. These walls must be braced or sheathed to resist lateral loads from earthquakes. In higher load regions, they should be sheathed. In all regions, storeys with knee-walls should be considered as storeys for the purpose of determining building height and the application of the Part 9 structural requirements.

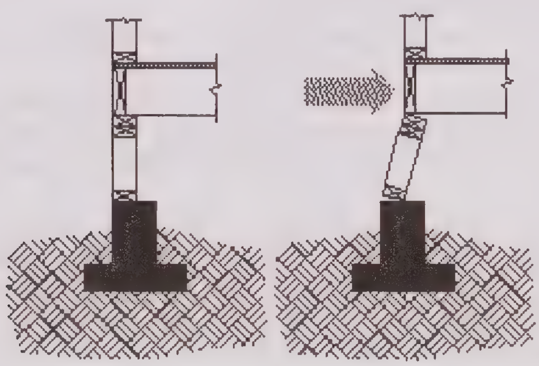


Figure A-9.4.1.1.(3)B
Crawl Space Knee-wall with Little Resistance to Lateral Loading

Thus, Part 9 buildings are not exempt from having to comply with the wind and earthquake loading requirements of Part 4. In many cases, these considerations can safely be ignored but, in certain configurations, the building's resistance to wind and earthquake loads must be carefully considered. See also A-9.23.10.2.

In cases where lateral load design is required, the "Engineering Guide for Wood Frame Construction" (CWC Guide) provides acceptable engineering solutions as an alternative to Part 4. The CWC Guide also contains alternative solutions and provides information on the applicability of the Part 9 prescriptive structural requirements to further assist designers and building officials to identify the appropriate design approach.

A-9.4.2.1.(1) Application of Simplified Part 9 Snow Loads.

The simplified specified snow loads described in Article 9.4.2.2. may be used where the structure is of the configuration that is typical of traditional wood-frame residential construction and its performance. This places limits on the spacing of joists, rafters and trusses, the spans of these members and supporting members, deflection under load, overall dimensions of the roof and the configuration of the roof. It assumes considerable redundancy in the structure.

Because very large buildings may be constructed under Part 9 by constructing firewalls to break up the building area, it is possible to have Part 9 buildings with very large roofs. The simplified specified snow loads may not be used when the total roof area of the overall structure exceeds 4 550 m^2. Thus, the simplified specified snow load calculation may be used for typical townhouse construction but would not be appropriate for much larger commercial or industrial buildings, for example.

The simplified specified snow loads are also not designed to take into account roof configurations that seriously exacerbate snow accumulation. This does not pertain to typical projections above a sloped roof, such as dormers, nor does it pertain to buildings with higher and lower roofs. Although two-level roofs generally lead to drift loading, smaller light-frame buildings constructed according to Part 9 have not failed under these loads. Consequently, the simplified calculation may be used in these cases. Rather, this limitation on application of the simplified calculation pertains to roofs with high parapets or significant other projections above the roof, such as elevator penthouses, mechanical rooms or larger equipment that would effectively collect snow and preclude its blowing off the roof.

The reference to Article 9.4.3.1. invokes, for roof assemblies other than common lumber trusses, the same performance criteria for deflection.

The unit weight of snow on roofs, γ, obtained from measurements at a number of weather stations across Canada varied from about 1.0 to 4.5 kN/m^3. An average value for use in design in lieu of better local data is $\gamma = 3.0\ kN/m^3$. In some locations the unit weight of snow may be considerably greater than 3.0 kN/m^3. Such locations include regions where the maximum snow load on the roof is reached only after contributions from many snowstorms, coastal regions, and regions where winter rains are considerable and where a unit weight as high as 4.0 kN/m^3 may be appropriate.

A-9.4.2.3.(1) Accessible Platforms Subject to Snow and Occupancy Loads.

Many platforms are subject to both occupancy loads and snow loads. These include balconies, decks, verandas, flat roofs over garages and carports. Where such a platform, or a segregated area of such a platform, serves a single dwelling unit, it must be designed for the greater of either the specified snow load or an occupancy load of 1.9 kPa. Where the platform serves more than one single dwelling unit or an occupancy other than a residential occupancy, higher occupancy loads will apply, as specified in Table 4.1.5.3.

A-9.4.2.4.(1) Specified Loads for Attics or Roof Spaces with Limited Accessibility.

Typical residential roofs are framed with roof trusses and the ceiling is insulated.

Residential trusses are placed at 600 mm on centre with web members joining top and bottom chords. Lateral web bracing is installed perpendicular to the span of the trusses. As a result, there is limited room for movement inside the attic or roof space or for storage of material. Access hatches are generally built to the minimum acceptable dimensions, further limiting the size of material that can be moved into the attic or roof space.

With exposed insulation in the attic or roof space, access is not recommended unless protective clothing and breathing apparatus are worn.

Thus, the attic or roof space is recognized as uninhabitable and loading can be based on actual dead load. In emergency situations or for the purpose of inspection, it is possible for a person to access the attic or roof space without over-stressing the truss or causing damaging deflections.

A-Table 9.4.4.1. Classification of Soils.

Sand or gravel may be classified by means of a picket test in which a 38 mm by 38 mm (2" x 2") picket bevelled at the end at 45° to a point is pushed into the soil. Such material is classified as "dense or compact" if a man of average weight cannot push the picket more than 200 mm into the soil and "loose" if the picket penetrates 200 mm or more.

Clay and silt may be classified as "stiff" if it is difficult to indent by thumb pressure, "firm" if it can be indented by moderate thumb pressure, "soft" if it can be easily penetrated by thumb pressure, where this test is carried out on undisturbed soil in the wall of a test pit.

A-9.4.4.4.(1) Soil Movement.

In susceptible soils, changes in temperature or moisture content can cause significant expansion and contraction. Soils containing pyrites can expand simply on exposure to air.

Expansion and Contraction due to Moisture

Clay soils are most prone to expansion and contraction due to moisture. Particularly wet seasons can sufficiently increase the volume of the soil under and around the structure to cause heaving of foundations and floors-on-ground, or cracking of foundation walls. Particularly dry seasons or draw-down of water by fast-growing trees can decrease the volume of the soil supporting foundations and floors-on-ground, thus causing settling.

Frost Heave

Frost heave is probably the most commonly recognized phenomenon related to freezing soil. Frost heave results when moisture in frost-susceptible soil (clay and silt) under the footings freezes and expands. This mechanism is addressed by requirements in Section 9.12. regarding the depth of excavations.

Ice Lenses

When moisture in frost-susceptible soils freezes, it forms an ice lens and reduces the vapour pressure in the soil in the area immediately around the lens. Moisture in the ground redistributes to rebalance the vapour pressures providing more moisture in the area of the ice lens. This moisture freezes to the lens and the cycle repeats itself. As the ice lens grows, it exerts pressure in the direction of heat flow. When lenses form close to foundations and heat flow is toward the foundation - as may be the case with unheated crawl spaces or open concrete block foundations insulated on the interior-the forces may be sufficient to crack the foundation.

Adfreezing

Ice lenses can adhere themselves to cold foundations. Where heat flow is essentially upward, parallel to the foundation, the pressures exerted will tend to lift the foundation. This may cause differential movement or cracking of the foundation. Heat loss through basement foundations of cast-in-place concrete or concrete block insulated on the exterior appears to be sufficient to prevent adfreezing. Care must be taken where the foundation does not enclose heated space or where open block foundations are insulated on the interior. The installation of semi-rigid glass fibre insulation has demonstrated some effectiveness as a separation layer to absorb the adfreezing forces.

Pyrites

Pyrite is the most common iron disulphide mineral in rock and has been identified in rock of all types and ages. It is most commonly found in metamorphic and sedimentary rock, and especially in coal and shale deposits.

Weathering of pyritic shale is a chemical-microbiological oxidation process that results in volume increases that can heave foundations and floors-on-ground. Concentrations of as little as 0.1% by weight have caused heaving. Weathering can be initiated simply by exposing the pyritic material to air. Thus, building on soils that contain pyrites in concentrations that will cause damage to the building should be avoided, or measures should be taken to remove the material or seal it. Material containing pyrites should not be used for backfill at foundations or for supporting foundations or floors-on-ground.

Where it is not known if the soil or backfill contains pyritic material in a deleterious concentration, a test is available to identify its presence and concentration.

References:

(1) Legget, R.F. and Crawford, C.B. Trees and Buildings. Canadian Building Digest 62, Division of Building Research, National Research Council Canada, Ottawa, 1965.

(2) Hamilton, J.J. Swelling and Shrinking Subsoils. Canadian Building Digest 84, Division of Building Research, National Research Council Canada, Ottawa, 1966.

(3) Hamilton, J.J. Foundations on Swelling and Shrinking Subsoils. Canadian Building Digest 184, Division of Building Research, National Research Council Canada, Ottawa, 1977.

(4) Penner, W., Eden, W.J., and Gratten-Bellew, P.E. Expansion of Pyritic Shales. Canadian Building Digest 152, Division of Building Research, National Research Council Canada, Ottawa, 1975.

(5) Swinton, M.C., Brown, W.C., and Chown, G.A. Controlling the Transfer of Heat, Air and Moisture through the Building Envelope. Small Buildings - Technology in Transition, Building Science Insight '90, Institute for Research in Construction, National Research Council Canada, Ottawa, 1990.

A-9.4.4.6. and A-9.15.1.1. Loads on Foundations.

The prescriptive solutions provided in Part 9 relating to footings and foundation walls only account for the loads imposed by drained earth. Drained earth is assumed to exert a load equivalent to the load that would be exerted by a fluid with a density of 480 kg/m^3. The prescriptive solutions do not account for surcharges from saturated soil or additional loads from heavy objects located adjacent to the building. Where such surcharges are expected, the footings and foundation walls must be designed and constructed according to Part 4.

A-9.5.1.4. Combination Rooms.

If a room draws natural light and natural ventilation from another area, the opening between the two areas must be large enough to effectively provide sufficient light and air. This is why a minimum opening of 3 m^2 is required, or the equivalent of the area of a set of double doors. The effectiveness of the transfer of light and air also depends on the size of the transfer opening in relation to the size of the dependent room; in measuring the area of the wall separating the two areas, the whole wall on the side of the dependent room should be considered, not taking into account offsets that may be in the surface of the wall.

The opening does not necessarily have to be in the form of a doorway; it may be an opening at eye level. However, if the dependent area is a bedroom, provision must be made for the escape window required by Article 9.7.1.3. to fulfill its safety function. This is why a direct passage is required between the bedroom and the other area; the equivalent of at least a doorway is therefore required for direct passage between the two areas.

A-9.5.2.3.(1) Stud Wall Reinforcement.

This provision for future attachment of grab bars in the main bathroom of a residential occupancy including houses requires the installation of suitable blocking in the stud wall. Sentence 9.31.2.3.(1) specifies the required load resistance.

A-3.8.3.8.(5) L-Shaped Grab Bar.

L-shaped grab bars provide greater support for people who rely on grab bars to assist them in transferring to and from a standing or seated position. Diagonally mounted grab bars are not suitable for the downward force necessary for support or for pulling upward. Hands can slip along the bar if it is set in a diagonal position. The use of two straight grab bars located at a 90° angle to one another is not acceptable.

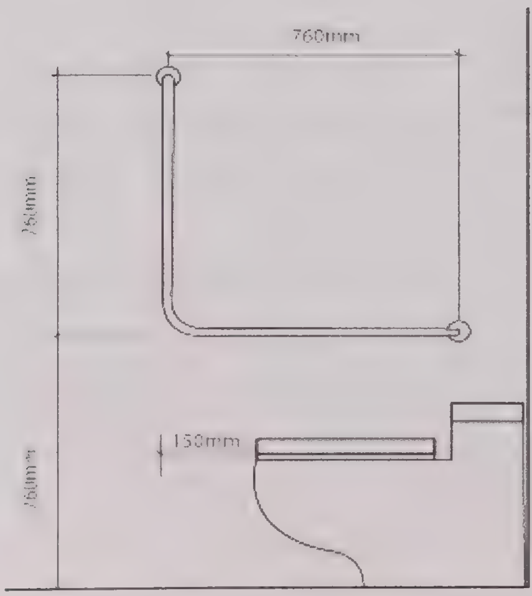


Figure A-3.8.3.8.(5)A
Compliant Continuous L-Shaped Grab Bar

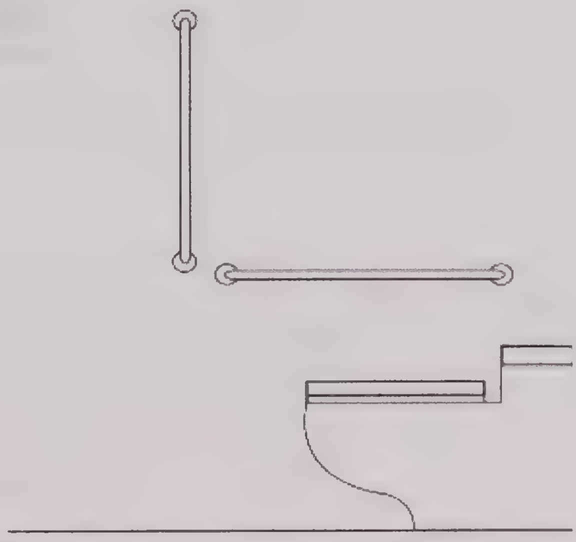


Figure A-3.8.3.8.(5)B
Non-Compliant Discontinuous L-Shaped Grab Bar

A-3.8.3.13.(2)(f) and (h) Shower Seat and Grab Bars.

Only one grab bar is required, to be installed on the wall next to the seat; a grab bar behind the seat prevents the user from leaning against the wall, while one located on the wall opposite the seat cannot be reached from the seated position. The use of two straight grab bars installed at a 90° angle to one another is not acceptable. The Code requires a continuous L-shaped grab bar. The seat itself may be used in conjunction with the bar for transfer. If design flexibility is required, fold away grab bars may be used as an alternative.

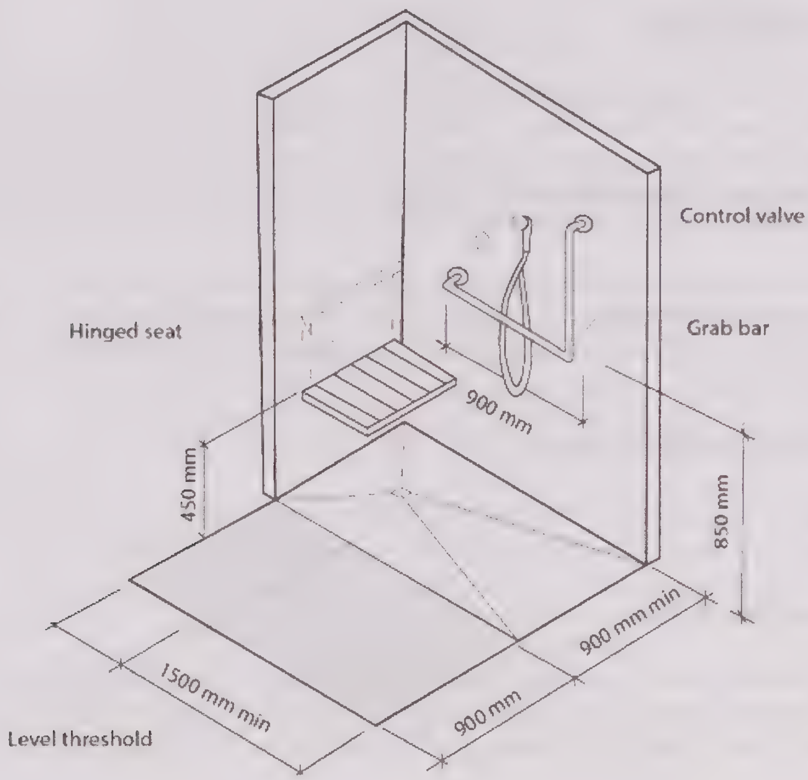


Figure A-3.8.3.13.
Accessible Shower

A-3.8.3.13.(4) Showers and Bathtubs.

The grab bars and their mounting position must facilitate getting in and out of the bathtub from a seated or standing position, as appropriate, to limit the need for twisting the body.

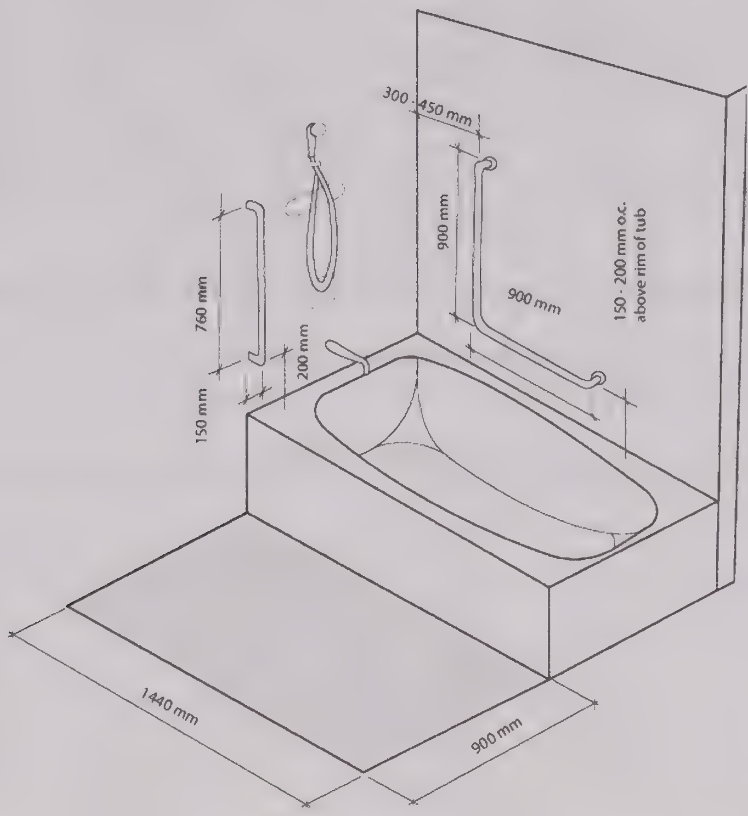


Figure A-3.8.3.13.(4)
Accessible Bathtub

A-9.6.1.2.(2) Mirrored Glass Doors.

Standard CAN/CGSB-82.6 covers mirrored glass doors for use on reach-in closets. It specifies that such doors are not to be used for walk-in closets.

A-9.6.1.3.(1) Maximum Glass Area.

Tables A-9.6.1.3.(1)A. to A-9.6.1.3.(1)F. may be used to select glass thickness for windows subject to the following conditions:

- The building has an essentially uniform distribution of paths for air leakage, including operable openings, but no large openings that would permit wind gusts to rapidly enter the building, e.g., loading or garage doors.
- The building has a height from grade to the uppermost roof of 12 m or less, and is located in a built-up area, no less than 120 m away from the boundary between this area and open terrain. (Where this criterion is not met, see Tables A-9.6.1.3.(1)D, to A-9.6.1.3.(1)F., which apply to buildings located on open terrain.)
- The building is not in an exceptionally exposed location such as a hilltop.

These six Tables are based on CAN/CGSB-12.20-M and the wind load provisions in Article 4.1.7.1. The maximum glass area values given in these Tables are intended to be equal to or smaller than those that would be determined using the standard and wind load provisions directly to design for each individual case.

Table A-9.6.1.3.(1)A.
Maximum Glass Area for Windows in Areas for which the 1-In-50 Hourly Wind Pressure (HWP) is less than 0.55 kPa(1)

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.58	0.96	1.47	2.04	2.84	4.74	6.65	9.74
Factory-sealed IG units(2)	1.02	1.71	2.68	3.74	5.24	7.93	9.92	13.92
Heat-strengthened or tempered	1.24	1.93	2.60	3.18	3.99	5.55	6.99	9.74
Wired	0.27	0.45	0.68	0.93	1.31	2.15	3.07	5.03
Column 1	2	3	4	5	6	7	8	9

Notes to Table A-9.6.1.3.(1)A.:

(1) The maximum hourly wind pressure with one chance in fifty of being exceeded in any one year, as provided in MMAH Supplementary Standard SB-1.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heal-strengthened or tempered) spaced at 12.7 mm.

Table A-9.6.1.3.(1)B.
Maximum Glass Area for Windows in Areas for which the 1-In-50 Hourly Wind Pressure (HWP) is less than 0.75 kPa(1)

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.42	0.68	1.02	1.42	2.04	3.34	4.70	7.65
Factory-sealed IG units(2)	0.72	1.19	1.85	2.56	3.64	6.01	8.35	11.83
Heat-strengthened	0.88	1.46	2.21	2.71	3.39	4.73	5.92	8.29
Tempered	1.18	1.64	2.21	2.71	3.39	4.73	5.92	8.29
Wired	0.20	0.32	0.50	0.68	0.94	1.55	2.19	3.60
Column 1	2	3	4	5	6	7	8	9

Notes to Table A-9.6.1.3.(1)B.:

(1) The maximum hourly wind pressure with one chance in fifty of being exceeded in any one year, as provided in MMAH Supplementary Standard SB-1.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heal-strengthened or tempered) spaced at 12.7 mm.

Table A-9.6.1.3.(1)C.
Maximum Glass Area for Windows In Areas for which the 1-in-50 Hourly Wind Pressure (HWP) Is less than 1.00 kPa(1)

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.30	0.50	0.77	1.05	1.45	2.40	3.40	5.62
Factory-sealed IG units(2)	0.52	0.86	1.31	1.86	2.57	4.30	6.10	9.89
Heat-strengthened	0.65	1.04	1.63	2.26	2.92	4.07	5.10	7.14
Tempered	1.01	1.42	1.90	2.33	2.92	4.07	5.10	7.14
Wired	0.16	0.26	0.38	0.52	0.71	1.15	1.63	2.69
Column 1	2	3	4	5	6	7	8	9

Notes to Table A-9.6.1.3.(1)C.:

(1) The maximum hourly wind pressure with one chance in fifty of being exceeded in any one year, as provided in MMAH Supplementary Standard SB-1.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heat-strengthened or tempered) spaced at 12.7 mm.

Table A-9.6.1.3.(1)D.
Maximum Glass Area for Windows in Areas for which the 1-In-50 Hourly Wind Pressure (HWP) is less than 0.55 kPa — OPEN TERRAIN[1]

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.46	0.75	1.16	1.60	2.25	3.76	5.32	8.70
Factory-sealed IG units[2]	0.30	1.34	2.11	2.93	4.10	6.90	9.66	12.53
Heat-strengthened	0.98	1.74	2.33	2.86	3.59	5.00	6.26	8.78
Tempered	1.25	1.74	2.33	2.86	3.59	5.00	6.26	8.78
Wired	0.22	0.36	0.55	0.76	1.05	1.75	2.47	4.09
Column 1	2	3	4	5	6	7	8	9

Notes to Table A-9.6.1.3.(1)D.:

(1) The maximum hourly wind pressure with one chance in fifty of being exceeded in any one year, as provided in MMAH Supplementary Standard SB-1.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heal-strengthened or tempered) spaced at 12.7 mm.

Table A-9.6.1.3.(1)E.
Maximum Glass Area for Windows in Areas for which the 1-In-50 Hourly Wind Pressure (HWP) is less than 0.75 kPa — OPEN TERRAIN[1]

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.33	0.54	0.83	1.14	1.61	2.67	3.75	6.14
Factory-sealed IG units[2]	0.57	0.94	1.47	2.04	2.85	4.75	6.72	10.97
Heat-strengthened	0.70	1.15	1.79	2.44	3.06	4.36	5.34	7.47
Tempered	1.06	1.48	1.99	2.44	3.06	4.36	5.34	7.47
Wired	0.16	0.26	0.40	0.55	0.76	1.24	1.77	2.93
Column 1	2	3	4	5	6	7	8	9

Notes to Table A-9.6.1.3.(1)E.:

(1) The maximum hourly wind pressure with one chance in fifty of being exceeded in any one year, as provided in MMAH Supplementary Standard SB-1.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heal-strengthened or tempered) spaced at 12.7 mm.

Table A-9.6.1.3.(1)F.
Maximum Glass Area for Windows in Areas for which the 1-in-50 Hourly Wind Pressure (HWP) is less than 1.00 kPa — OPEN TERRAIN(1)

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.25	0.40	0.62	0.84	1.17	1.94	2.75	4.50
Factory-sealed IG units(2)	0.42	0.68	1.04	1.46	2.05	3.41	4.87	7.92
Heat-strengthened	0.51	0.84	1.30	1.79	2.52	3.69	4.60	6.44
Tempered	0.92	1.28	1.72	2.10	2.63	3.69	4.60	6.44
Wired	0.12	0.20	0.30	0.41	0.57	0.94	1.31	2.18
Column 1	2	3	4	5	6	7	8	9

Notes to Table A-9.6.1.3.(1)F.:

(1) The maximum hourly wind pressure with one chance in fifty of being exceeded in any one year, as provided in MMAH Supplementary Standard SB-1.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heat-strengthened or tempered) spaced at 12.7 mm.

A-Table 9.6.1.3. Glass in Doors.

Maximum areas in Table 9.6.1.3. for other than fully tempered glazing are cut off at 1.50 m^2, as this would be the practical limit after which safety glass would be required by Sentence 9.6.1.4.(2).

A-9.7.3.2.(1)(a) Minimizing Condensation.

The total prevention of condensation on the surfaces of fenestration products is difficult to achieve and, depending on the design and construction of the window or door, may not be absolutely necessary. Clause 9.7.3.2.(1)(a) therefore requires that condensation be minimized, which means that the amount of moisture that condenses on the inside surface of a window, door or skylight, and the frequency at which this occurs, must be limited. The occurrence of such condensation must be sufficiently rare, the accumulation of any water must be sufficiently small, and drying must be sufficiently rapid to prevent the deterioration of moisture-susceptible materials and the growth of fungi.

A-9.7.4.2.(1) Standards Referenced for Windows, Doors and Skylights.

Canadian Requirements in the Harmonized Standard

In addition to referencing the Canadian Supplement, CSA A440S1, "Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights," the Harmonized Standard, AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights," contains some Canada-specific test criteria.

Standards Referenced for Excluded Products

Clause 1.1, General, of the Harmonized Standard defines the limits to the application of the standard with respect to various types of fenestration products. A list of exceptions to the application statement identifies a number of standards that apply to excluded products. Compliance with those standards is not required by the Code; the references are provided for information purposes only.

Label Indicating Performance and Compliance with Standard

The Canadian Supplement requires that a product's performance ratings be indicated on a label according to the designation requirements in the Harmonized Standard and that the label include

- design pressure, where applicable,
- negative design pressure, where applicable,
- water penetration test pressure, and
- the Canadian air infiltration and exfiltration levels.

It should be noted that, for a product to carry a label in Canada, it must meet all of the applicable requirements of both the Harmonized Standard and the Canadian Supplement, including the forced entry requirements.

Water Penetration Resistance
For the various performance grades listed in the Harmonized Standard, the corresponding water penetration resistance test pressures are a percentage of the design pressure. For R-class products, water penetration resistance test pressures are 15% of design pressure. In Ontario, driving rain wind pressures (DRWP) have been determined for the locations listed in MMAH Supplementary Standard SB-1.

To achieve equivalent levels of water penetration resistance for all locations, the Canadian Supplement includes a provision for calculating specified DRWP at the building site considering building exposure. Specified DRWP values are, in some cases, greater than 15% of design pressure and, in other cases, less than 15% of design pressure. For a fenestration product to comply with the Code, it must be able to resist the structural and water penetration loads at the building site. Reliance on a percentage of design pressure for water penetration resistance in the selection of an acceptable fenestration product will not always be adequate. Design pressure values are reported on a secondary designator, which is required by the Canadian Supplement to be affixed to the window. The DRWP given in the Canadian Supplement should be used for all products covered in the scope of the Harmonized Standard.

Uniform Load Structural Test
The Harmonized Standard specifies that fenestration products be tested at 150% of design pressure for wind (specified wind load) and that skylights and roof windows be tested at 200% of design pressure for snow (specified snow load). With the change in the 2006 Building Code to a 1-in-50 return period for wind load, a factor of 1.4 rather than 1.5 is now applied for wind. The Building Code has traditionally applied a factor of 1.5 rather than 2.0 for snow. Incorporating these lower load factors into the Code requirements for fenestration would better reflect acceptable minimum performance levels; however, this has not been done in order to avoid adding complexity to the Code, to recognize the benefits of Canada-US harmonization, and to recognize that differentiation of products that meet the Canadian versus the US requirements would add complexity for manufacturers, designers, specifiers and regulatory officials.

Condensation Resistance
The Harmonized Standard identifies three test procedures that can be used to determine the condensation resistance of windows and doors. Only the physical test procedure given in CSA A440.2, which is referenced in Table 9.7.3.3., can be used to establish Temperature Index (I) values. Computer simulation tools can also be used to estimate the relative condensation resistance of windows, but these methods employ different expressions of performance known as Condensation Resistance Factors (CR). I and CR values are not interchangeable.

Where removable multiple glazing panels (RMGP) are installed on the inside of a window, care should be taken to hermetically seal the RMGP against the leakage of moisture-laden air from the interior into the cavity on the exterior of the RMGP because the moisture transported by the air could lead to significant condensation on the interior surface of the outside glazing.

Basement Windows
Clause 8.4.2, Basement Windows, of the Harmonized Standard refers to products that are intended to meet Code requirements for ventilation and emergency egress. The minimum test size of 800 mm x 360 mm (total area of 0.288 m^2) specified in the standard will not provide the minimum openable area required by the Code for bedrooms (i.e. 0.35 m^2 with no dimension less than 380 mm) and the means to provide minimum open area identified in the standard is inconsistent with the requirements of the Code (see Subsection 9.9.10. for bedroom windows). The minimum test size specified in the standard will also not provide the minimum ventilation area of 0.28 m^2 required for non-heating-season natural ventilation (see Article 9.32.2.2.).

Greenhouse Windows
Greenhouse-type windows feature a sloped, roof-like top portion, which is subjected to the same snow loads as roofs. The Canadian Supplement only applies the snow load calculation to skylights, which do not include greenhouse windows according to the definition for skylights given in the Canadian Supplement and the Harmonized Standard. Where such windows are used, it is recommended that snow loads on the top portion of the window be taken into account.

A-9.7.5.2.(1) Forced Entry Via Glazing in Doors and Sidelights.

There is no mandatory requirement that special glass be used in doors or sidelights, primarily because of cost. It is, however, a common method of forced entry to break glass in doors and sidelights to gain access to door hardware and unlock the door from the inside. Although insulated glass provides increased resistance over single glazing, the highest resistance is provided by laminated glass. Tempered glass, while stronger against static loads, is prone to shattering under high, concentrated impact loads.

Laminated glass is more expensive than annealed glass and must be used in greater thicknesses. Figure A-9.7.5.2.(1) shows an insulated sidelight made of one pane of laminated glass and one pane of annealed glass. This method reduces the cost premium that would result if both panes were laminated.

Consideration should be given to using laminated glazing in doors and accompanying sidelights regulated by Article 9.6.1.3., in windows located within 900 mm of locks in such doors, and in basement windows.

Underwriters' Laboratories of Canada have produced ULC-S332, "Burglary Resisting Glazing Material", which provides a test procedure to evaluate the resistance of glazing to attacks by thieves. While it is principally intended for plate glass show windows, it may be of value for residential purposes.

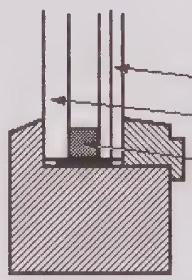


Figure A-9.7.5.2.(1)
Combined Laminated / Annealed Glazing

A-9.7.5.2.(2) Resistance of Doors to Forced Entry.

This Sentence designates standard ASTM F476, " Test Methods for Security of Swinging Door Assemblies" as an alternate to compliance with the prescriptive requirements for doors and hardware. The annex to the standard provides four security classifications, with acceptance criteria, depending on the type of building and the crime rate of the area in which it is located. The Building Code has only specified Grade 10, the minimum level. The annex suggests the following guidelines be followed when selecting security levels for door assemblies:

- Grade 10: This is the minimum security level and is quite adequate for single-family residential buildings located in stable, low-crime areas.
- Grade 20: This is the low-medium security level and is designed to provide security for residential buildings located in average crime-rate areas and for apartments in both low and average crime-rate areas.
- Grade 30: This is the medium-high security level and is designed to provide security for residential buildings located in higher than average crime-rate areas or for small commercial buildings in average or low crime-rate areas.
- Grade 40: This is the high security level and is designed for small commercial buildings located in high crime-rate areas. This level could also be used for residential buildings having an exceptionally high incidence of semi-skilled burglary attacks.

All these grades satisfy the Code and can be considered for use where a higher level of security is desired or warranted.

A-9.7.5.2.(6) Door Fasteners.

The purpose of the requirement for 30 mm screw penetration into solid wood is to prevent the door from being dislodged from the jamb due to impact forces. It is not the intent to prohibit other types of hinges or strikeplates that are specially designed to provide equal or greater protection.

A-9.7.5.2.(8) Hinged Doors.

Methods of satisfying this Sentence include either using non-removable pin hinges or modifying standard hinges by screw fastening a metal pin in a screw hole in one half of the top and bottom hinges. When the door is closed, the projecting portion of the pin engages in the corresponding screw hole in the other half of the hinge and then, even if the hinge pin is taken out, the door cannot be removed.

A-9.7.5.3.(1) Resistance of Windows to Forced Entry.

Although this Sentence only applies to windows within 2 m of adjacent ground level, certain house and site features, such as balconies or canopy roofs, allow for easy access to windows at higher elevations. Consideration should be given to specifying break-in resistant windows in such locations.

This Sentence does not apply to windows that do not serve the interior of the dwelling unit, such as windows to garages, sun rooms or greenhouses, provided connections between these spaces and the dwelling unit are secure.

One method that is often used to improve the resistance of windows to forced entry is the installation of metal "security bars". However, while many such installations are effective in increasing resistance to forced entry, they may also reduce or eliminate the usefulness of the window as an exit in case of fire or other emergency that prevents use of the normal building exits. Indeed, unless such devices are easily openable from the inside, their installation in some cases would contravene the requirements of Article 9.9.10.1., which requires every bedroom that does not have an exterior door to have at least one window that is large enough and easy enough to open that it can be used as an exit in case of emergency. Thus an acceptable security bar system should be easy to open from the inside while still providing increased resistance to entry from the outside.

A-9.8.4. Step Dimensions.

The Code distinguishes three principal types of stair treads and uses the following terminology to describe them:

- rectangular treads are found in straight-run flights;
- angled treads are found in curved flights;
- winders are a special type of angled tread described in Appendix Note A-9.8.4.5. See Figure A-9.8.4.A.

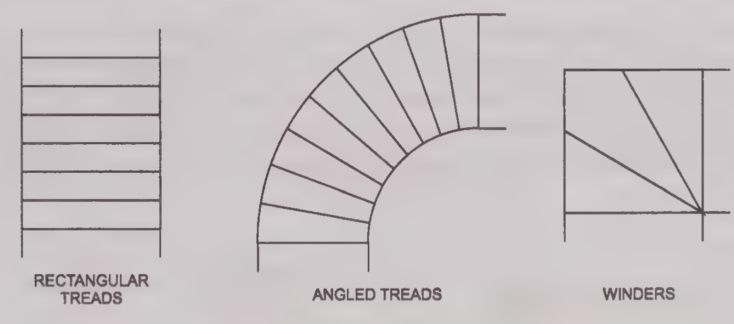


Figure A-9.8.4.A.
Types of Treads

Articles 9.8.4.1. to 9.8.4.6. specify various dimensional limits for steps. Figure A-9.8.4.B illustrates the elements of a step and how these are to be measured.

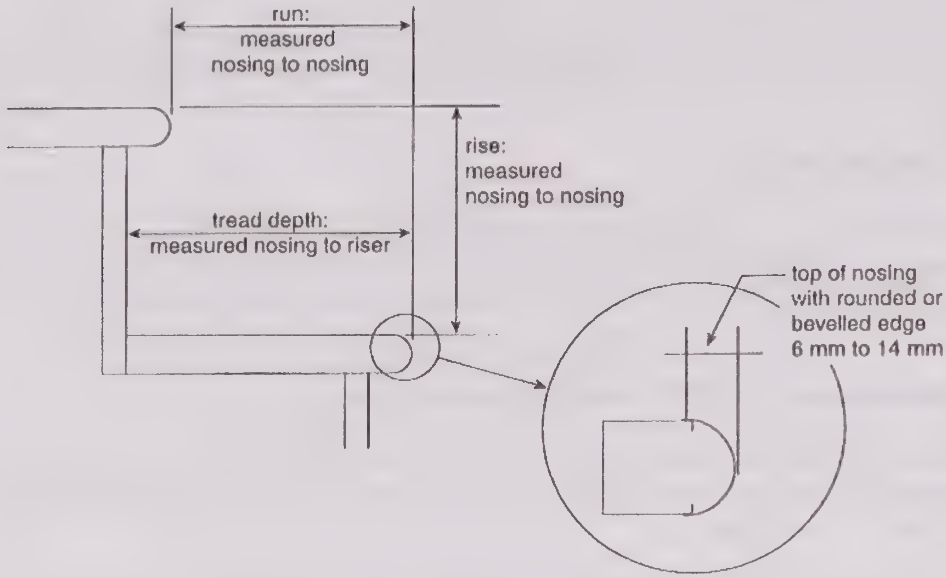


Figure A-9.8.4.B.
Elements of Steps and their Measurement

A-9.8.4.5. Winders.

The safest method of incorporating a change in the direction of a stair is to use a landing. Within a dwelling unit, however, where occupants are familiar with their environment, winders are an acceptable method of reducing the amount of floor area devoted to the stair and have not been shown to be more hazardous than a straight run of steps. Nevertheless, care is required to ensure that winders are as safe as possible. Experience has shown that 30° winders are the best compromise and require the least change in the natural gait of the stair user; 45° winders are also acceptable, as they are wider. The Code permits winders to turn through any angle between 30° and 45°, inclusive. This allows winder-type stairs to change direction through any angle between 30° (1 winder) and 90° (2 or 3 winders).

A-9.8.4.6.(1) Tread Projection and Leading Edge of Steps.

A sloped or bevelled edge on nosings or leading edges of steps will make the tread more visible through light modelling. The sloped portion of the leading edge must not be too wide so as to reduce the risk of slipping of the foot. To reduce the risk of tripping, the leading edge must not reduce the effective tread depth to less than the required minimum tread depth less 15 mm. Similarly, the projection of the tread behind the nosing can also cause tripping, particularly during a person's ascent. Figure A-9.8.4.6. illustrates the various dimensional requirements stated in Sentence 9.8.4.6.(1).

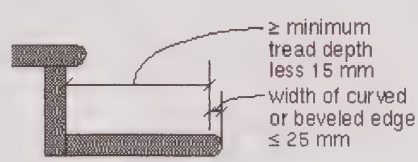


Figure A-9.8.4.6.
Tread Depth and Treatment of Leading Edge

A-9.8.6.3.(1) Dimensions of Landings.

Figure A-9.8.6.3.(1) illustrates various landing configurations.

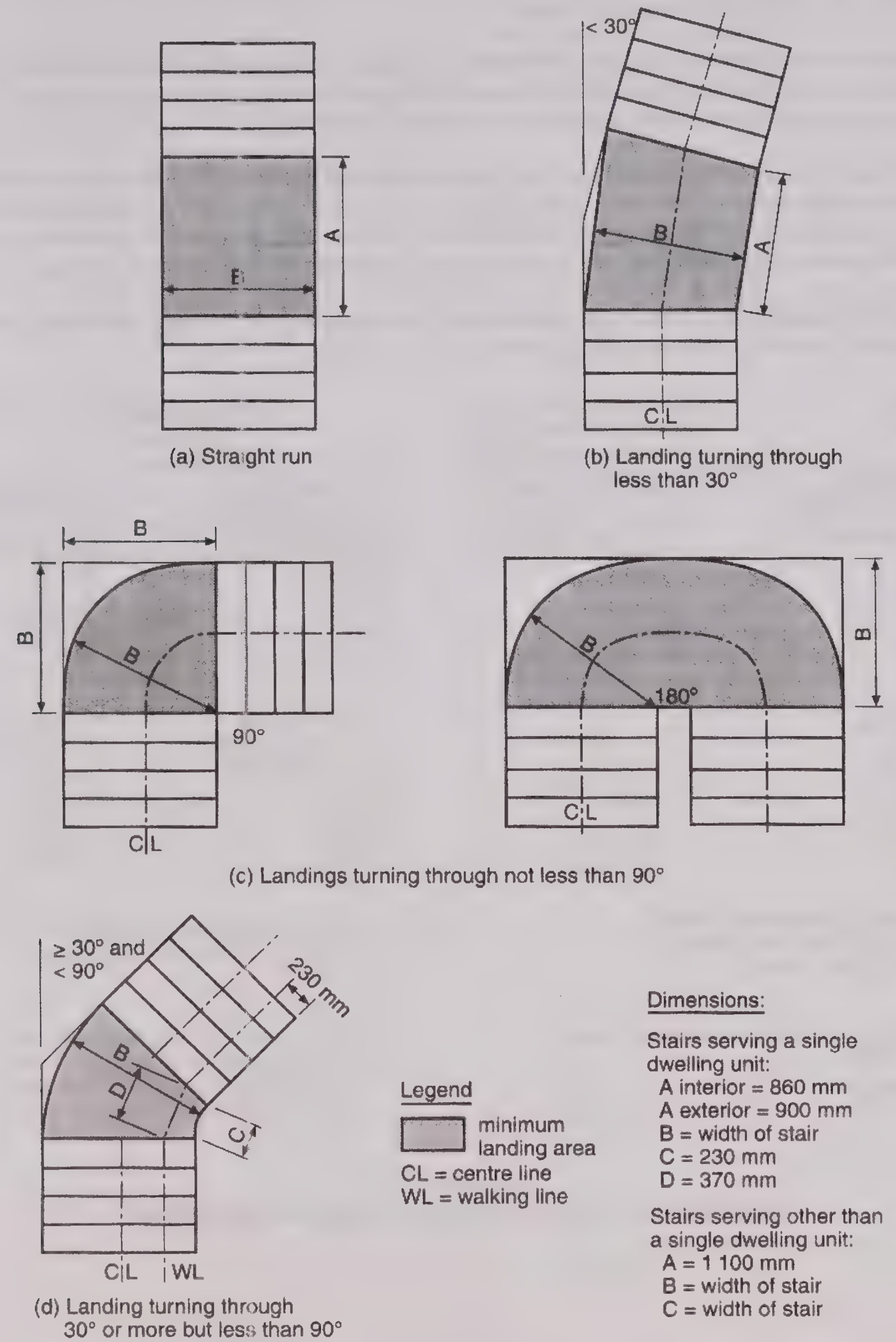


Figure A-9.8.6.3.(1)
Landing Configurations

A-9.8.7.2. Continuity of Handrails.

The guidance and support provided by handrails is particularly important at the beginning and end of ramps and flights of stairs and at changes in direction such as at landings and winders.

The intent of the requirement in Sentence (1) for handrails to be continuous throughout the length of the stair is that the handrail be continuous from the bottom riser to the top riser of the stair. The required handrail may start back from the bottom riser only if it is supported by a newel post installed on the bottom tread. (See Figure A-9.8.7.2.)

For stairs or ramps serving a single dwelling unit, the intent of the requirement in Sentence (2) for handrails to be continuous throughout the length of the flight is that the handrail be continuous from the bottom riser to the top riser of the flight. Once again, the required handrail may start back from the bottom riser only if it is supported by a newel post installed on this line. (See Figure A-9.8.7.2.) With regard to stairs serving a single dwelling unit, the handrail may terminate at landings.

In the case of stairs within dwelling units that incorporate winders, the handrail should be configured so that it will in fact provide guidance and support to the stair user throughout the turn through the winder.

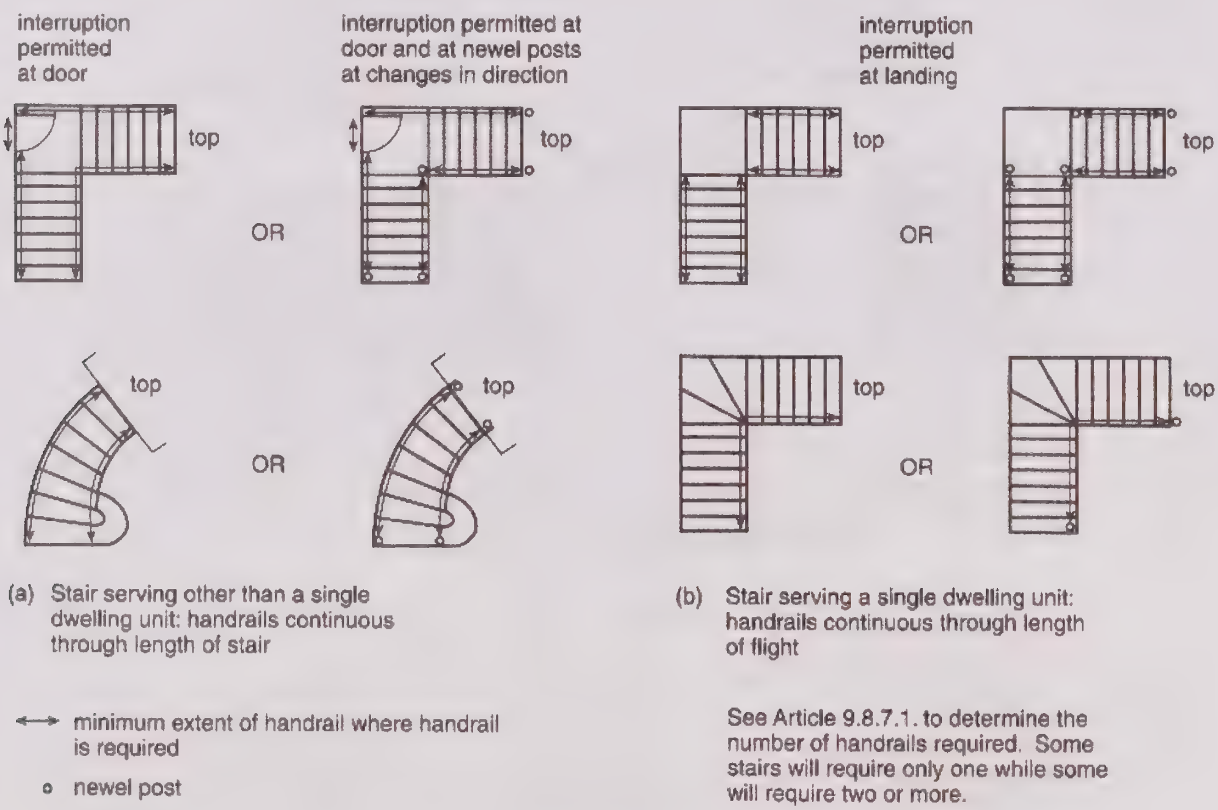


Figure A-9.8.7.2.
Continuity of Handrails at the Top and Bottom of Stairs and Flights of Stairs

A-9.8.7.3.(1) Termination of Handrails.

Handrails are required to be installed so as not to obstruct pedestrian travel. To achieve this end, the rail should not extend so far into a hallway as to reduce the clear width of the hallway to less than the required width. Where the stair terminates in a room or other space, likely paths of travel through that room or space should be assessed to ensure that any projection of the handrail beyond the end of the stair will not interfere with pedestrian travel. As extensions of handrails beyond the first and last riser are not required in dwelling units [See Sentence 9.8.7.3.(2)] and as occupants of dwellings are generally familiar with their surroundings, the design of dwellings would not generally be affected by this requirement.

Handrails are also required to terminate in a manner that will not create a safety hazard to blind or visually impaired persons, children whose heads may be at the same height as the end of the rail, or persons wearing loose clothing or carrying items that might catch on the end of the rail. One approach to reducing potential hazards is returning the handrail to a wall, floor or post. Again, within dwelling units, where occupants are generally familiar with their surroundings, returning the handrail to a wall, floor or post may not be necessary. For example, where the handrail is fastened to a wall and does not project past the wall into a hallway or other space, a reasonable degree of safety is assumed to be provided; other alternatives may provide an equivalent level of protection.

A-9.8.7.3.(2) Handrail Extensions.

As noted in Appendix Note A-9.8.7.2., the guidance and support provided by handrails is particularly important at the beginning and end of ramps and flights of stairs and at changes in direction. The extended handrail provides guidance and allows users to steady themselves upon entering or leaving a ramp or flight of stairs. Such extensions are particularly useful to visually-impaired persons, and persons with physical disabilities or who are encumbered in their use of the stairs or ramp.

A-9.8.7.4. Height of Handrails.

Figure A-9.8.7.4. illustrates how to measure handrail height.

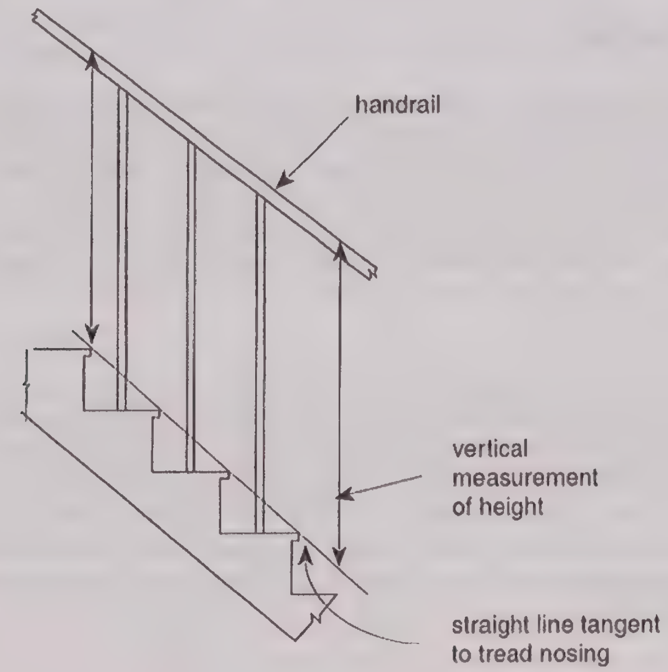


Figure A-9.8.7.4.
Measuring Handrail Height

A-9.8.7.5.(2) Handrail Sections.

Handrails are intended to provide guidance and support to stair users. To fulfil this intent, handrails must be "graspable". Acceptable handrail sections include, but are not limited to, those shown in Figure A-9.8.7.5.(2).

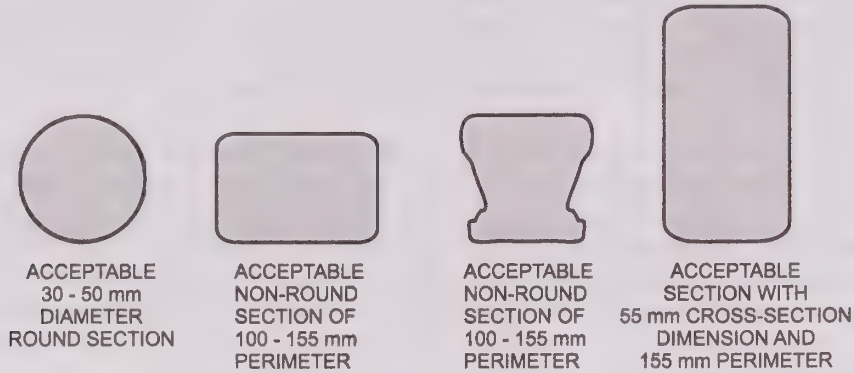


Figure A-9.8.7.5.(2)
Handrail Sections

A-9.8.7.7. Attachment of Handrails.

Handrails are intended to provide guidance and support to the stair user and to arrest falls. The loads on handrails may therefore be considerable. The attachment of handrails serving a single dwelling unit may be accepted on the basis of experience, structural design, or the prescriptive requirements of Sentence 9.8.7.7.(2).

A-9.8.8.1. Required Guards.

The requirements relating to guards stated in Part 9 are based on the premise that, wherever there is a difference in elevation of 600 mm or more between two floors, or between a floor or other surface to which access is provided for other than maintenance purposes and the next lower surface, the risk of injury in a fall from the higher surface is sufficient to warrant the installation of some kind of barrier to reduce the chances of such a fall. A wall along the edge of the higher surface will obviously prevent such a fall, provided the wall is sufficiently strong that a person cannot fall through it. Where there is no wall, a guard must be installed. Because guards clearly provide less protection than walls, additional requirements apply to guards to ensure that a minimum level of protection is provided. These relate to the characteristics described in notes A-9.8.8.3., A-9.8.8.5.(1) and (2), A-9.8.8.5.(3) and A-9.8.8.6.

Examples of such surfaces where the difference in elevation could exceed 600 mm and consequently where guards would be required include, but are not limited to, landings, porches, balconies, mezzanines, galleries, and raised walkways. Especially in exterior settings, surfaces adjacent to walking surfaces, stairs or ramps often are not parallel to the walking surface or the surface of the treads or ramps. Consequently, the walking surface, stair or ramp may need protection in some locations but not in others. (See Figure A-9.8.8.1.) In some instances, grades are artificially raised close to walking surfaces, stairs or ramps to avoid installing guards. This provides little or no protection for the users. That is why the requirements specify differences in elevation not only immediately adjacent to the construction but also for a distance of 1 200 mm from it by requiring that the slope of the ground be within certain limits. (See Figure A-9.8.8.1.)

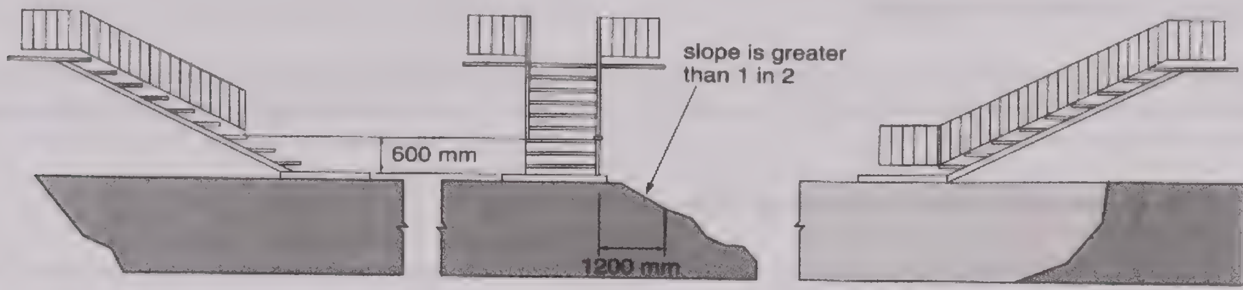


Figure A-9.8.8.1.
Required Locations of Guards

A-9.8.8.1.(5) Height of Window Sills Above Floors or Ground.

The primary intent of the requirement is to minimize the likelihood of small children falling significant heights from open windows. Reflecting reported cases, the requirement applies only to dwelling units and generally those located on the second floor or higher of residential or mixed use buildings where the windows are essentially free-swinging or free-sliding.

Free-swinging or free-sliding means that a window that has been cracked open can be opened further by simply pushing on the openable part of the window. Care must be taken in selecting windows, as some with special operating hardware can still be opened further by simply pushing on the window.

Casement windows with crank operators would be considered to conform to Clause (1)(b). To provide additional safety, where slightly older children are involved, occupants can easily remove the crank handles from these windows. Awning windows with scissor hardware, however, may not keep the window from swinging open once it is unlatched. Hopper windows would be affected only if an opening is created at the bottom as well as at the top of the window. The requirement will impact primarily on the use of sliding windows which do not incorporate devices in their construction that can be used to limit the openable area of the window.

The 100 mm opening limit is consistent with widths of openings that small children can fall through. It is only invoked, however, where the other dimension of the opening is more than 380 mm. Again, care must be taken in selecting a window. At some position, scissor hardware on an awning window may break up the open area such that there is no unobstructed opening with dimensions greater than 380 mm and 100 mm. At another position, however, though the window is not open much more, the hardware may not adequately break up the opening. The 480 mm height off the floor recognizes that furniture is often placed under windows and small children are often good climbers.

A-9.8.8.2. Loads on Guards.

Guards must be constructed so as to be strong enough to protect persons from falling under normal use. Many guards installed in dwelling units or on exterior stairs serving one or two dwelling units have demonstrated acceptable performance over time. The loading specified in the first row of Table 9.8.8.2. is intended to be consistent with the performance provided by these guards. Guards constructed in accordance with MMAH Supplementary Standard SB-7 are deemed to meet the requirements of Article 9.8.8.2.

The load on guards within dwelling units, or on exterior guards serving not more than two dwelling units, is to be imposed over an area of the guard such that, where standard balusters are used and installed at the maximum 100 mm spacing permitted for required guards, 3 balusters will be engaged. Where the balusters are wider, only two may be engaged unless they are spaced closer together. Where the guard is not required, and balusters are installed more than 100 mm apart, fewer balusters may be required to carry the imposed load.

A-9.8.8.3. Minimum Heights.

Guard heights are generally based on the waist heights of average persons. Generally, lower heights are permitted in dwelling units because the occupants become familiar with the potential hazards, and situations which lead to pushing and jostling under crowded conditions are less likely to arise.

A-9.8.8.5.(1) and (2) Risk of Falling Through Guards.

The risk of falling through a guard is especially prevalent for children. Therefore, the requirements are stringent for guards in all buildings except industrial buildings, where children arc unlikely to be present except under strict supervision.

A-9.8.8.5.(3) Risk of Children Getting Their Heads Lodged Between Balusters.

The requirements to prevent children falling through guards also serve to provide adequate protection against this problem. However, guards are often installed where they are not required by the Code; i.e., in places where the difference in elevation is less than 600 mm. In these cases, there is no need to require the openings between balusters to be less than 100 mm. However, there is a range of openings between 100 mm and 200 mm in which children can get their heads stuck. Therefore, openings in this range are not permitted except in buildings of industrial occupancy, where children are unlikely to be present except under strict supervision.

A-9.8.8.6. Risk of Children Climbing Over Guards.

Guards are sometimes constructed with horizontal or near-horizontal members between balusters such that a ladder effect is achieved. This can be very tempting for young children to climb, thus exposing themselves to risk of falling over the guard. Such construction is not permitted for required guards in buildings of residential occupancy.

A-9.9.10.1.(1) Bedroom Window Opening Areas and Dimensions.

Although the minimum opening dimensions required for height and width are 380 mm, a window opening that is 380 mm by 380 mm would not comply with the minimum area requirements. (See Figure A-9.9.10.1.(1))

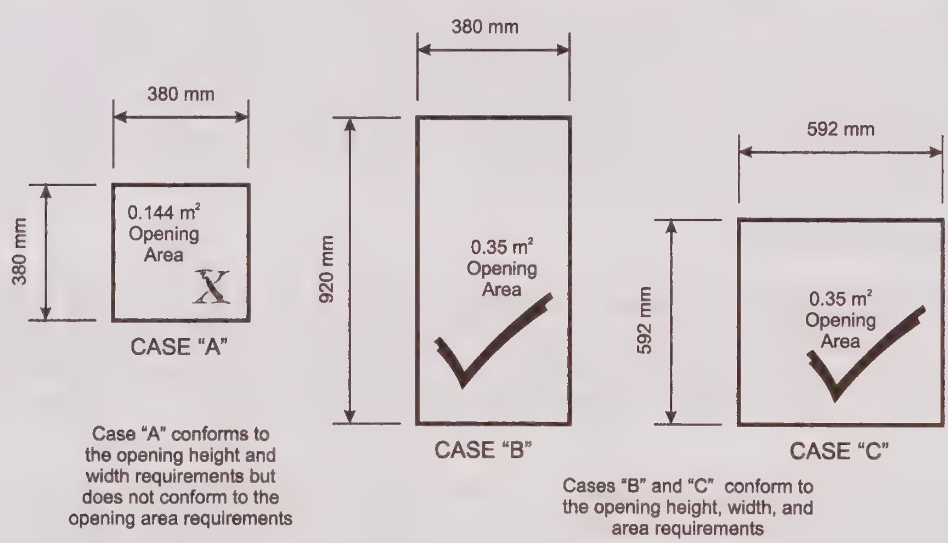


Figure A-9.9.10.1.(1)
Window Opening Areas and Dimensions

A-9.9.10.1.(2) Bedroom Window Height.

Sentence 9.9.10.1.(2) requires every floor level which contains a bedroom to have at least one window or door to the exterior that is large enough and easy enough to open that it can be used as an exit in case of a fire. However, Article 9.9.10.1. does not set a maximum sill height for such a window in a basement area. It is recommended that the sills of windows intended for use as emergency exits from basement bedroom areas be not higher than 1.5 m above the floor. Sometimes it is difficult to avoid having the sill higher than this; e.g., skylights, windows in basement bedrooms. In these cases, it is recommended that access to the window be improved by some means such as built-in furniture installed below the window. (See Figure A-9.9.10.1.(2))

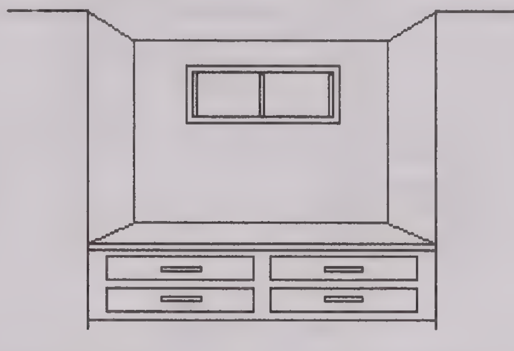


Figure A-9.9.10.1.(2)
Built-in Furniture to Improve Access to a Window

A-9.9.10.1.(5) Window Opening into a Window Well.

Sentence 9.9.10.1.(5) specifies that there must be a minimum clearance of 550 mm in front of designated escape windows to allow persons to escape a basement bedroom in an emergency. This specified minimum clearance is consistent with the minimum required width for means of egress from a floor area (see Article 9.9.5.5.) and the minimum required width for path of travel on exit stairs (see Article 9.9.6.1.). It is considered the smallest acceptable clearance between the escape window and the facing wall of the window well that can accommodate persons trying to escape a bedroom in an emergency given that they are not moving straight through the window but must move outward and up, and must have sufficient space to change body orientation.

Once this clearance is provided, no additional clearance is needed for windows with sliders, casements, or inward-opening awnings. However, for windows with outward-opening awnings, additional clearance is needed to provide the required 550 mm beyond the outer edge of the sash. (See Figure A-9.9.10.1.(5).)

Depending on the likelihood of snow accumulation in the window well, it could be difficult — if not impossible — to escape in an emergency. The window well should be designed to provide sufficient clear space for a person to get out the window and then out the well, taking into account potential snow accumulation.

Hopper windows (bottom-hinged operators) should not be used as escape windows in cases where the occupants would be required to climb over the glass.

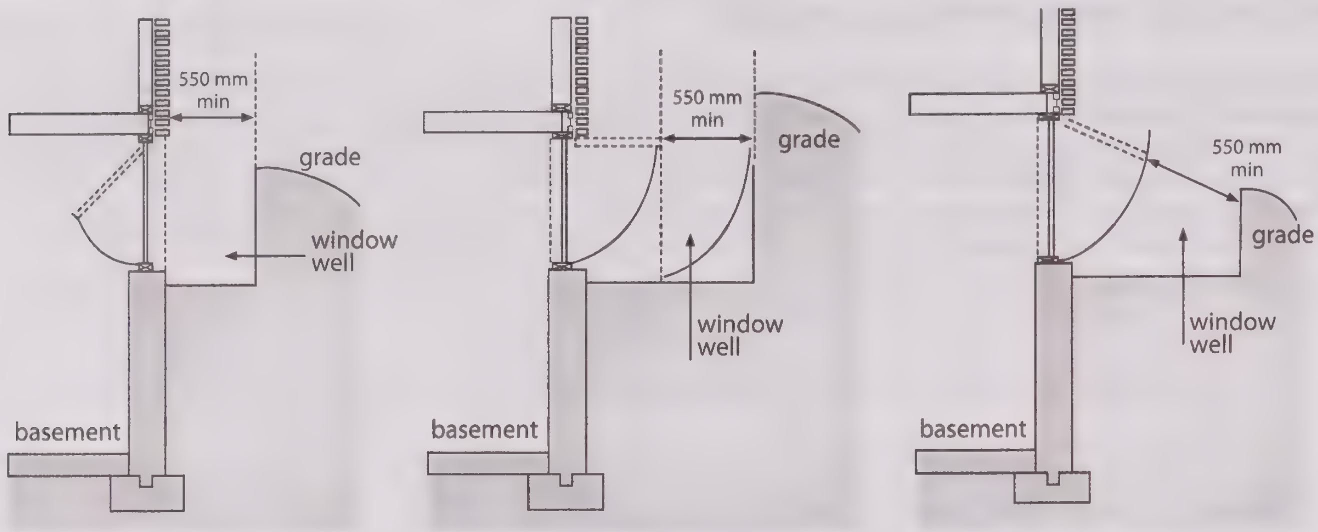


Figure A-9.9.10.1.(5)
Windows Providing a Means of Escape that Open into a Window Well.

A-9.10.1.3.(8) Installation of Sprinkler, Standpipe and Hose Systems.

Some provisions captured by the cross-reference to Part 3 go beyond the intended application of the cross-reference.

In the context of the cross-reference, Subsections 3.2.5. and 3.2.9. apply only where sprinkler, standpipe or hose systems are installed in a Part 9 building, whether the installation is voluntary or for the purpose of complying with the provisions in Part 9. Provisions in Part 3 that identify buildings or spaces in which these systems are to be installed do not apply.

A-9.10.3.1.(1) Fire and Sound Resistance of Building Assemblies.

The Tables found in MMAH Supplementary Standard SB-3 may be used to select building assemblies for compliance with Article 9.10.3.1. and Subsection 9.11.2. Assembles not listed in those Tables are equally acceptable provided their fire and sound resistance can be demonstrated to meet the above-noted requirements on the basis of tests referred to in 9.10.3.1. and 9.11.1. or by using the data in MMAH Supplementary Standard SB-2.

A-9.10.9.6.(1) Penetration of Fire-Rated Assemblies by Service Equipment.

This Sentence, together with Article 3.1.9.1., is intended to ensure that the integrity of fire-rated assemblies is maintained where they are penetrated by various types of service equipment.

For buildings regulated by the requirements in Part 3, fire stop materials used to seal openings around building services, such as pipes, ducts and electrical outlet boxes, must meet a minimum level of performance demonstrated by standard test criteria.

This is different from the approach in Part 9. Because of the type of construction normally used for buildings regulated by the requirements in Part 9, it is assumed that this requirement is satisfied by the use of generic fire stop materials such as mineral wool, gypsum plaster or Portland cement mortar.

Also, see Appendix Note A-3.1.9.

A-9.10.9.16.(4) Separation Between Dwelling Units and Garages.

The gas-tight barrier between a dwelling unit and an attached garage is intended to provide reasonable protection from carbon monoxide and gasoline fumes entering the dwelling unit. Construction assemblies incorporating an air barrier system will perform adequately with respect to gas tightness, provided reasonable care is exercised where the wall or ceiling is pierced by building services. Where a garage is open to the adjacent attic space above the dwelling unit it serves, a gas-tight barrier in the dwelling unit ceiling will also provide protection. Unit masonry walls forming the separation between a dwelling unit and an adjacent garage should be provided with two coats of sealer or plaster or covered with gypsum wallboard on the side of the wall exposed to the garage. All joints must be sealed to ensure continuity of the barrier. (See also Sentences 9.25.3.3.(3) to (8).)

Also, see Appendix Note A-3.1.9.

A-9.10.12.4.(1) Protection of Overhang of Common Roof Space.

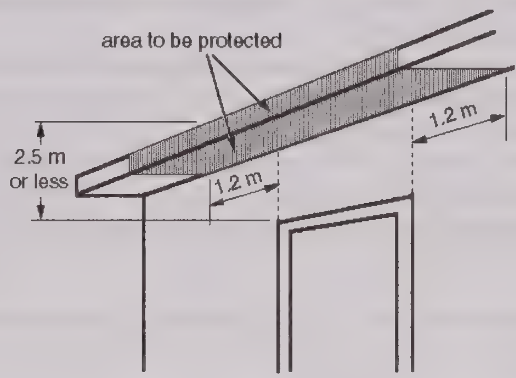


Figure A-9.10.12.4.(1)
Protection of Overhang of Common Roof Space

A-9.10.12.4.(3) Protection at Soffits.

The materials required by this Sentence to be used as protection for soffit spaces in certain locations do not necessarily have to be the finish materials. They can be installed either behind the finishes chosen for the soffits or in lieu of these.

A-9.10.15.1.(1) Application of Subsection 9.10.15.

Subsection 9.10.15. applies to the spatial separation between buildings of residential occupancy where there is no dwelling unit above another dwelling unit. Such buildings include detached houses, semi-detached houses (doubles) and row houses, where there is no dwelling unit above another dwelling unit. The designer has the option of using either Subsection 9.10.14. or Subsection 9.10.15. for the determination of spatial separation requirements for these types of buildings. However, the requirements of these two subsections cannot be mixed.

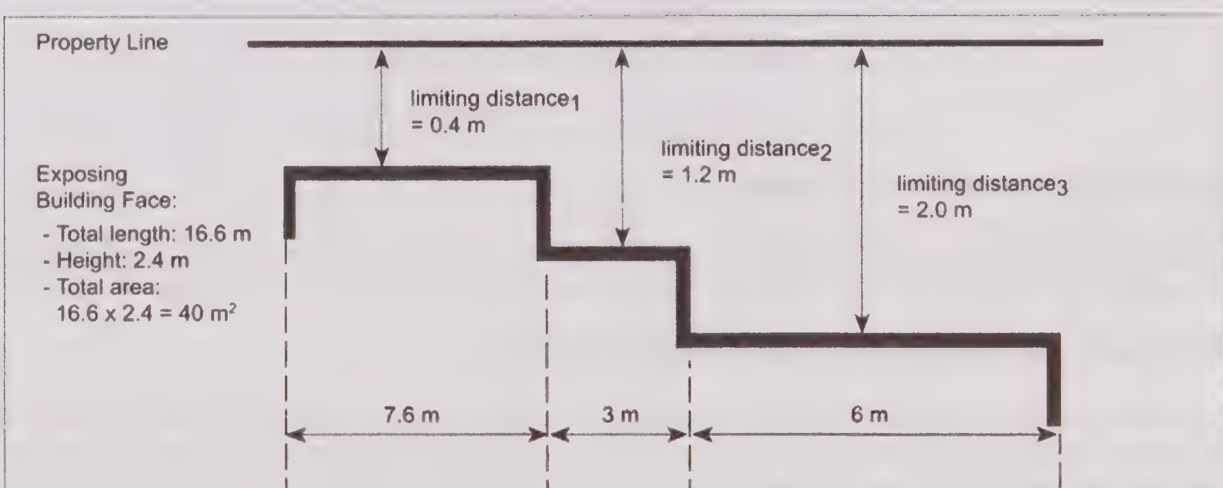
A-9.10.15.4.(2) Staggered or Skewed Exposing Building Faces of Houses.

Studies at the National Fire Laboratory of the National Research Council have shown that, where an exposing building face is stepped back from the property line or is at an angle to the property line, it is possible to increase the percentage of glazing in those portions of the exposing building face further from the property line without increasing the amount of radiated energy that would reach the property line in the event of a fire in such a building. Figures A-9.10.15.4.(2)-A to A-9.10.15.4.(2)-C show how Sentences 9.10.15.4.(1) and (2) could be applied to exposing building faces that are stepped back from or not parallel to the property line.

The following procedure can be used to establish the maximum permitted area of glazed openings for such facades:

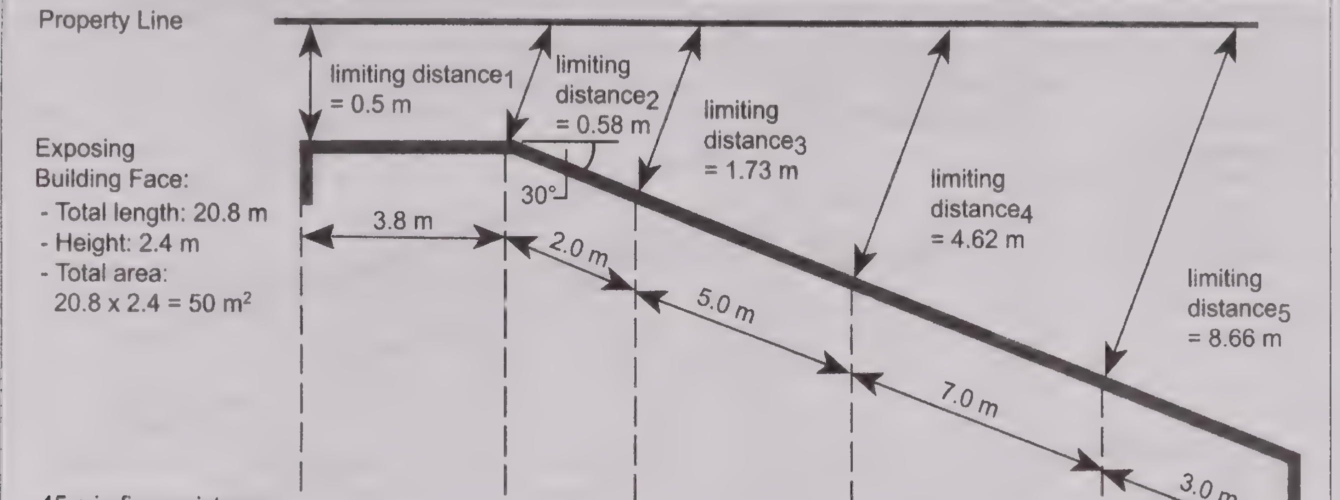
1. Calculate the total area of the exposing building face, i.e. facade of the fire compartment, as described in the definition of exposing building face.
2. Identify the portions into which the exposing building face is to be divided. It can be divided in any number of portions, not necessarily of equal size.
3. Measure the limiting distance for each portion. The limiting distance is measured along a line perpendicular to the wall surface from the point closest to the property line.
4. Establish the line in Table 9.10.15.4. from which the maximum permitted percentage area of glazed openings will be read. The selection of the line depends on the maximum area of exposing building face for the whole fire compartment, including all portions, as determined in Step 1.
5. On that line, read the maximum percentage area of glazed openings permitted in each portion of the exposing building face according to the limiting distance for that portion.
6. Calculate the maximum area of glazed openings permitted in each portion. The area is calculated from the percentage found applied to the area of that portion.

Table 9.10.15.4. is used to determine the maximum area of glazed openings. Therefore, unglazed portions of doors need not be counted, as for other types of buildings.



45 min fire-resistance rating	required	not required	not required
Noncombustible cladding	required	not required	not required
Permitted % of glazed openings	0%	7%	11%
Permitted area of glazed openings	0	3 x 2.4 x 0.07 = 0.50 m²	6 x 2.4 x 0.11 = 1.58 m²

Figure A-9.10.15.4.(2)-A
Example of Determination of Criteria for the Exposing Building Face of a Staggered Wall of a House



45 min fire-resistance rating	required	required	not required	not required	not required
Noncombustible cladding	required	required	not required	not required	not required
Permitted % of glazed openings	0%	0%	8%(1)	28%(1)	100%
Permitted area of glazed openings	0	0	5.0 x 2.4 x 0.08 = 0.96 m^2	7.0 x 2.4 x 0.28 = 4.70 m^2	3.0 x 2.4 x 1.0 = 7.2 m^2

Figure A-9.10.15.4.(2)-B
Example of Determination of Criteria for the Exposing Building Face of a Skewed Wall of a House With Some Arbitrary Division of the Wall

Note to Figure A-9.10.15.4.(2)-B:

(1) To simplify the calculations, choose the column for the lesser limiting distance nearest to the actual limiting distance. Interpolation for limiting distance is also acceptable and may result in a slightly larger permitted area of glazed openings. Interpolation can only be used for limiting distances greater than 1.2 m.

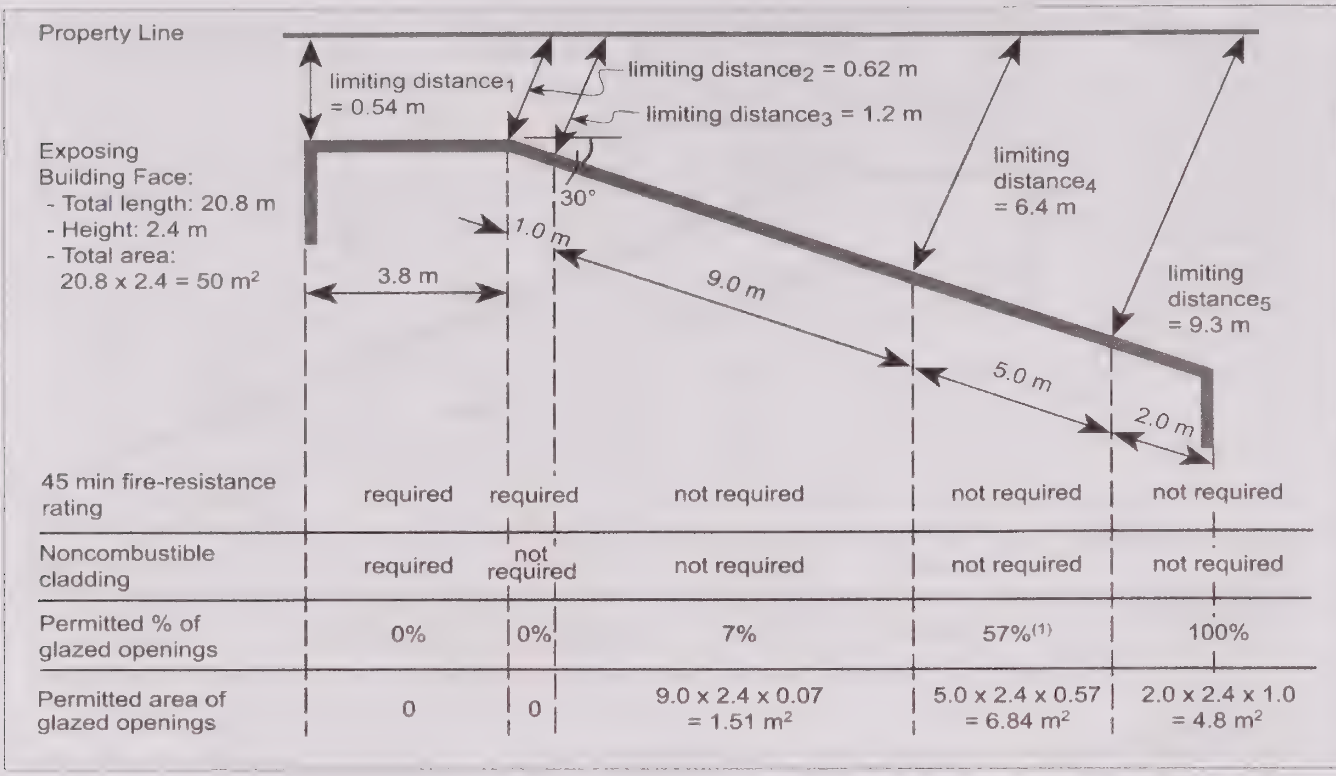


Figure A-9.10.15.4.(2)-C
Example of Determination of Criteria for the Exposing Building Face of a Skewed Wall of a House With a Different Arbitrary Division of the Wall

Note to Figure A-9.10.15.4.(2)-C:
(1) To simplify the calculations, choose the column for the lesser limiting distance nearest to the actual limiting distance. Interpolation for limiting distance is also acceptable and may result in a slightly larger permitted area of glazed openings. Interpolation can only be used for limiting distances greater than 1.2 m.

A-9.10.19.3.(1) Location of Smoke Alarms.

Statistics have shown that next to kitchen fires, fires originating in bedrooms within dwelling units account for the second highest causes of fire deaths in homes.

The requirement for smoke alarms in sleeping rooms (bedrooms) provides early detection and warning of fires originating in sleeping rooms. Smoke alarms located outside sleeping rooms are required as they are better capable of detecting a fire originating outside of the room.

A smoke alarm is not required on each level in a split-level dwelling unit as each level does not count as a separate storey. Determine the number of storeys in a split-level dwelling unit and which levels are part of which storey as follows:

1. establish grade, (See definition of "grade" in Sentence 1.4.1.2.(1) of Division A.);
2. identify the first storey, (See definition of "first storey" in Sentence 1.4.1.2.(1) of Division A.);
3. identify the basement, (See definition of "basement" in Sentence 1.4.1.2.(1) of Division A.);
4. identify the second storey and, where applicable, the third storey.

Additional Smoke Alarms Outside of Sleeping Areas
As a minimum, one smoke alarm is required to be installed on each storey, preferably on the upper level of each one. As noted above, however, when the dwelling unit contains more than one sleeping area, a smoke alarm must be installed to serve each area. Where the sleeping areas are on two levels of a single storey in a split-level dwelling unit, an additional smoke alarm must be installed so that both areas are protected. See Figure A-9.10.19.3.(1).

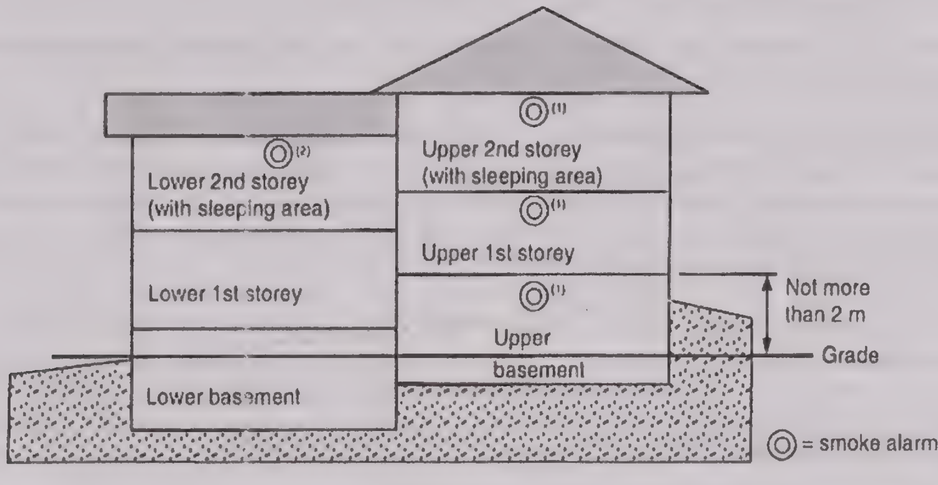


Figure A-9.10.19.3.(1)
Two-Storey Split-Level Building

Notes to Figure A-9.10.19.3.(1):
(1) One smoke alarm required for each of the basement, first storey and second storey.
(2) An additional smoke alarm is required on the lower level of the second storey outside the sleeping rooms

A-9.10.19.1.(3) Smoke Alarms with Visual Alarm Component.

Visual smoke alarms can alert people who are deaf, deafened or hard of hearing to the presence of smoke in the dwelling just as the alarm sound provides an alert to people with no or low vision or who are sighted. The visual alarm provides an extra level of safety alerts to building residents.

The visual alarm component may be integrated or an add-on to the smoke alarm and is not required to be on battery backup. The visual component includes a strobe light that needs to meet certain requirements including light intensity, flash rate, and colour in order that the light does not trigger seizures.

A-9.10.19.3.(3) Smoke Alarms with Visual Alarm Component.

Visual smoke alarms can alert people who are deaf, deafened or hard of hearing to the presence of smoke in the dwelling just as the alarm sound provides an alert to people with no or low vision or who are sighted. The visual alarm provides an extra level of safety alerts to building residents.

The visual alarm component may be integrated or an add-on to the smoke alarm and is not required to be on battery backup. The visual component which includes a strobe light that needs to meet certain requirements for light intensity, flash rate, etc. in order that the light does not trigger seizures.

A-9.10.20.3.(1) Fire Department Access Route Modification.

In addition to other considerations taken into account in the planning of fire department access routes, special variations could be permitted for a house or residential building that is protected with an automatic sprinkler system. The sprinkler system must be

designed in accordance with the appropriate NFPA standard and there must be assurance that water supply pressure and quantity are unlikely to fail. These considerations could apply to buildings that are located on the sides of hills and are not conveniently accessible by roads designed for fire fighting equipment and also to infill housing units that are located behind other buildings on a given property.

A-9.11.1.1.(1) Sound Transmission Class Ratings.

The specified STC rating of 50 is considered the minimum acceptable value, but many builders prefer to design for STC 55 or more in high quality accommodation.

Another reason to choose assemblies rated higher than STC 50 is that the STC ratings of assemblies are based on laboratory tests, but the sound transmission of any assembly as constructed in the field may be significantly less than its rating. This can be due to sound leaks, departures from design, poor workmanship or indirect (flanking) transmission paths overlooked in design. To provide a margin of safety to compensate for these, builders often select wall and floor systems that have been rated at least 5 points higher than the design STC rating in laboratory tests.

Sound leaks can occur where one wall meets another, the floor, or the ceiling. Leaks may also occur where the wall finish is cut for the installation of equipment or services. Avoid back-to-back electrical outlets or medicine cabinets. Carefully seal cracks or openings so structures are effectively airtight. Apply sealant below the plates in stud walls, between the bottom of drywall sheets and the structure behind, around all penetrations for services and, in general, wherever there is a crack, a hole or the possibility of one developing. Sound-absorbing material inside a well-designed wall decreases sound transmission. It has another advantage; it also helps to reduce the effects of leaks due, perhaps, to poor workmanship.

Indirect or flanking transmission arises where the parts of a building are rigidly connected together and where cavities in hollow walls or floors, or continuous lightweight layers connect apartments. Sound travels in cavities, as vibration along surfaces and through walls, ceilings and floors to adjacent rooms. Many paths other than the direct one through the party wall or floor may be involved. To achieve good sound insulation, transmission along flanking paths must be minimized by introducing breaks and resilient connections in the construction. Some examples of bad and good details are shown in Figure 9.11.1.1.(1).

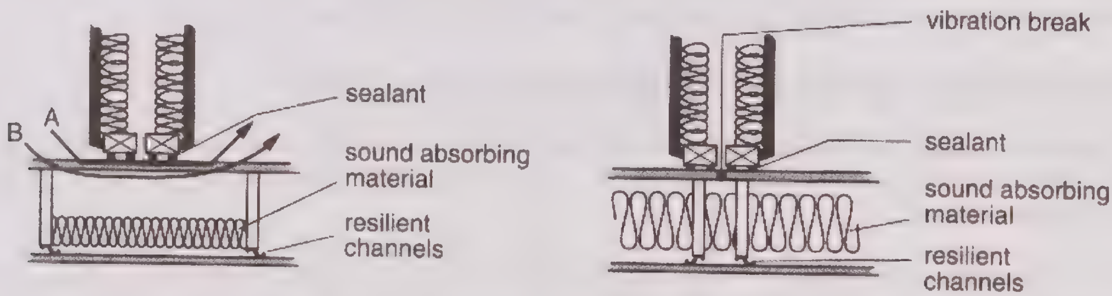


Figure A-9.11.1.1.(1)
Cross Section Through Wall/floor Junctions Impact Noise

Changes to construction should not be made without consultation with someone competent in the field of acoustical design. Adding extra layers of drywall to walls in an attempt to reduce sound transmission, can actually increase it if done incorrectly. For example, attaching drywall on resilient channels directly to an existing wall or ceiling usually increases low frequency sound transmission. Adding an additional layer of drywall inside a double layer wall will also seriously increase sound transmission. Adding blocking inside walls to reduce the risk of fire spread should be done so it does not increase vibration transmission from one part of a wall or floor to the other.

To verify that acoustical privacy is being achieved, a field test can be done at an early stage in the construction; ASTM E336, "Measurement of Airborne Sound Attenuation Between Rooms in Buildings" will give a complete measurement. A simpler and less expensive method is ASTM E597, "Determining a Single Number Rating of Airborne Sound Insulation in Multi Unit Building Specifications". The rating provided by this test is usually within 2 points of the STC obtained from ASTM E336. It is useful for verifying performance and finding problems during construction. Alterations can then be made prior to project completion.

Impact Noise

Section 9.11. has no requirements for control of impact noise transmission. Footstep and other impacts can cause severe annoyance in multi-family residences. Builders concerned about quality and reducing occupant complaints will ensure that floors are designed to minimize impact transmission. A recommended criterion is that bare floors (tested without a carpet) should achieve an impact insulation class (IIC) of 55. Some lightweight floors that satisfy this requirement may still cause complaints about low frequency impact noise transmission. Adding carpet to a floor will always increase the IIC rating but will not necessarily reduce low frequency noise transmission. Good footstep noise rejection requires fairly heavy floor slabs or floating floors.

Most frequently used methods of test for impact noise are ASTM E492, "Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using The Tapping Machine", or ASTM E1007, "Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures".

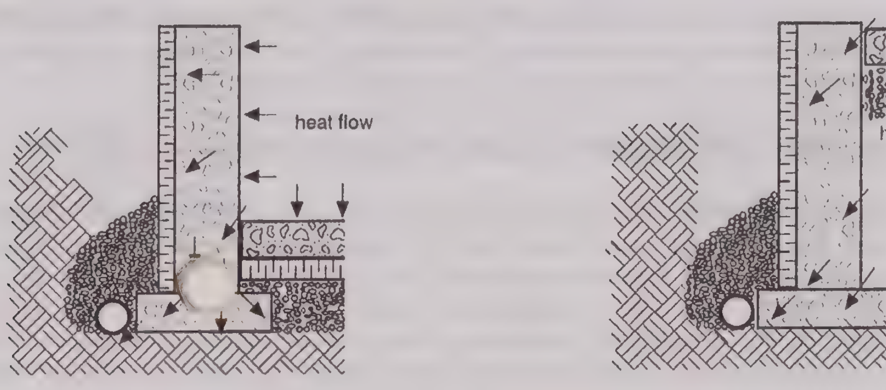
Machinery Noise

Elevators, garbage chutes, plumbing, fans, and heat pumps are common sources of noise in buildings. To reduce annoyance from these, they should be placed as far as possible from sensitive areas. Vibrating parts should be isolated from the building structure using resilient materials such as neoprene or rubber.

A-Table 9.12.2.2. Minimum Depths of Foundations.

The requirements for clay soils or soils not clearly defined are intended to apply to those soils that are subject to significant volume changes with changes in moisture content.

A-9.12.2.2.(2) Depth and Insulation of Foundations.



(a) Insulated in a manner allowing heat flow
to the soil beneath the footings

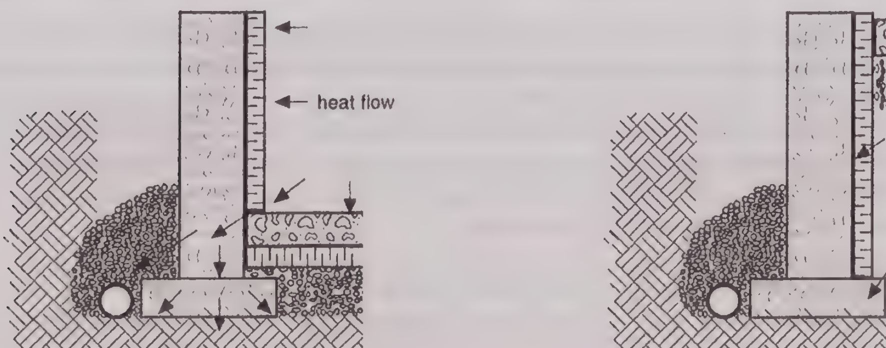


Figure A-9.12.2.2.(2)
Foundation Insulation and Heat Flow to Footings

A-9.12.3.3.(1) Deleterious Material in Backfill.

The deleterious debris referred to in this provision includes, but is not limited to:

- organic material and other material subject to decomposition and compaction, which could have an adverse effect on grading around the building,
- materials that will off-gas and have the potential to pose a health hazard, and
- materials that are incompatible with materials used in the foundations, footings, drainage materials or components, or other elements of the building whose required performance would be adversely affected.

A-9.13.2.6. Protection of Interior Finishes from Moisture.

Excess water from cast-in-place concrete and ground moisture tends to migrate toward interior spaces, particularly in the spring and summer. Where moisture-susceptible materials, such as finishes or wood members, are in contact with the foundation wall, the moisture needs to be controlled by installing a moisture barrier on the interior surface of the foundation wall that extends from the underside of the interior finish up the face of the wall to a point just above the level of the ground outside.

The reason the moisture barrier on the interior surface of the foundation wall must be terminated near ground level is to allow any moisture that finds its way into the finished wall cavity from the interior space (through leaks in the air or vapour barrier) to diffuse to the exterior. If the vapour permeance of dampproofing membranes or coatings exceeds 170 ng/(Pa•s•m^2), such moisture barriers may be carried full height; if their vapour permeance is less than that, this moisture risks being trapped on the interior surface of the moisture barriers. The permeance limit corresponds to the lower limit for breather-type membranes, such as asphalt-impregnated sheathing paper.

Some insulation products can also be used to protect interior finishes from the effects of moisture. They have shown acceptable performance when applied over the entire foundation wall because, in this case, they also provide vapour barrier and moisture barrier functions and possibly also the air barrier function. Where a single product provides all these functions, there is no risk of trapping moisture between two functional barriers with low water vapour permeance.

A-9.13.2.7.(1) and (2) Polyethylene Under Slabs-on-Ground.

Finishing a concrete slab placed directly on polyethylene can, in many cases, cause problems for the inexperienced finisher. A rule of finishing, whether concrete is placed on polyethylene or not, is to never finish or "work" the surface of the slab while bleed water is present or before all the bleed water has risen to the surface and evaporated. If finishing operations are performed too early, such as before all the bleed water has risen and evaporated, surface defects such as blisters, crazing, scaling and dusting can result. This is often the case with slabs placed directly on polyethylene. The amount of bleed water that may come to the surface and the time required for this to happen is increased from that of a slab placed on a compacted granular base. The excess water in the mix from the bottom portion of the slab cannot bleed downward and out of the slab and be absorbed into the granular material below, because of the polyethylene. Therefore, all bleed water, including that from the bottom of the slab, must now rise through the slab to the surface. Quite often in such cases, finishing operations are begun too soon and surface defects result.

One solution that is often suggested is to place a layer of sand between the polyethylene and the concrete. However, this is not an acceptable solution for the following reason: it is unlikely that the polyethylene will survive the slab pouring process entirely intact. Nevertheless, the polyethylene will still be effective in retarding the flow of soil gas if it is in intimate contact with the concrete; soil gas will only be able to penetrate where a break in the polyethylene coincides with a crack in the concrete. The majority of concrete cracks will probably be underlain by intact polyethylene. On the other hand, if there is an intervening layer of a porous medium, such as sand, soil gas will be able to travel laterally from a break in the polyethylene to the nearest crack in the concrete and the total system will be much less resistant to soil gas penetration.

To reduce and/or control the cracking of concrete slabs, it is necessary to understand the nature and causes of volume changes of concrete and in particular those relating to drying shrinkage. The total amount of water in a mix is by far the largest contributor to the amount of drying shrinkage and resulting potential cracking that may be expected from a given concrete. The less total amount of water in the mix, the less volume change (due to evaporation of water), which means the less drying shrinkage that will occur. To lessen the volume change and potential cracking due to drying shrinkage, a mix with the lowest total amount of water that is practicable should always be used. To lower the water content of a mix, superplasticizers are often used to provide the needed workability of the concrete during the placing operation. High water/cementing materials ratio concretes usually have

high water content mixes. They should be avoided to minimize drying shrinkage and cracking of the slab. The water/cementing materials ratio for slabs-on-ground should be no higher than 0.55.

A-9.13.4. Exclusion of Soil Gas.

Outdoor air entering a dwelling through above-grade leaks in the building envelope normally improves the indoor air quality in the dwelling by reducing the concentrations of pollutants and water vapour. It is only undesirable because it cannot be controlled. On the other hand, air entering a dwelling through below-grade leaks in the envelope may increase the water vapour content of the indoor air and may also bring in a number of pollutants which it picks up from the soil. This mixture of air, water vapour and pollutants is sometimes referred to as "soil gas". One pollutant often found in soil gas is radon.

Radon is a colourless, odourless, radioactive gas that occurs naturally as a result of the decay of radium. It is found to varying degrees as a component of soil gas in all regions of Canada and is known to enter dwelling units by infiltration into basements and crawl spaces. The presence of the decay products of radon in sufficient quantity can lead to increased risk of lung cancer.

The potential for high levels of radon infiltration is very difficult to evaluate prior to construction and thus a radon problem may only become apparent once the building is completed and occupied. MMAH Supplementary Standard SB-9 requires the application of certain radon exclusion measures in dwellings where methane or radon gasses are known to be a problem.

The principal method of resisting the ingress of all soil gases, a resistance which is required for all buildings (see Sentence 9.13.4.2.(1)), is to seal the interface between the soil and the occupied space, so far as is reasonably practicable. Sections 9.18. and 9.25. contain requirements for air and soil gas barriers in assemblies in contact with ground, including those in crawl spaces. Providing control joints to reduce cracking of foundation walls and airtight covers for sump pits (see Section 9.14.) are other measures that can help achieve this objective. The requirements provided in Subsection 9.25.3. are explained in Appendix Notes A-9.25.3.4. and 9.25.3.6. and A-9.25.3.6.(2) and (3).

The principal method of excluding radon is to ensure that the pressure difference across the ground space interface is positive (i.e., towards the outside) so that the inward flow of radon through any remaining leaks will be minimized. The requirements provided in Article 9.13.4.3. are explained in Appendix Note A-9.13.4.3.

A-9.14.2.1.(2) Insulation Applied to the Exterior of Foundation Walls.

In addition to the prevention of heat loss, some types of mineral fibre insulation, such as rigid glass fibre, are installed on the exterior of basement walls for the purpose of moisture control. This is sometimes used instead of crushed rock as a drainage layer between the basement wall and the surrounding soil in order to facilitate the drainage of soil moisture. Water drained by this drainage layer must be carried away from the foundation by the footing drains or the granular drainage layer in order to prevent it from developing hydro-static pressure against the wall. Provision must be made to permit the drainage of this water either by extending the insulation or crushed rock to the drain or by the installation of granular material connecting the two. The installation of such drainage layer does not eliminate the need for normal waterproofing or dampproofing of walls as specified in Section 9.13.

A-9.15.1.1. Application of Footing and Foundation Requirements to Decks and Similar Structures.

Decks, balconies, verandas and similar platforms that are attached to a building or that have an area greater than 10 m^2 are, by definition, considered as buildings or parts of buildings. Consequently, they are subject to the requirements in Section 9.15.

A-9.15.1.1.(1)(c) and A-9.20.1.1.(1)(b) Flat Insulating Concrete Form Walls.

Insulating concrete form (ICF) walls are concrete walls that are cast into polystyrene forms, which remain in place after the concrete has cured. Flat ICF walls are solid ICF walls where the concrete is of uniform thickness over the height and width of the wall.

A-9.15.2.4.(1) Preserved Wood Foundations - Design Assumptions.

Tabular data and figures in CAN/CSA-S406, "Construction of Preserved Wood Foundations" are based upon the general principles provided in CAN/CSA-O86.1, "Engineering Design in Wood" with the following assumptions:

- soil bearing capacity: 75 kPa or more,
- clear spans for floors: 5 m or less,
- floor loadings: 1.9 kPa for first floor and suspended floor, and 1.4 kPa for second storey floor,
- foundation wall heights: 2.4 for slab floor foundation, 3.0 m for suspended wood floor foundation,
- top of granular layer to top of suspended wood floor: 600 mm,
- lateral load from soil pressure: equivalent to fluid pressure of 4.7 kPa per metre of depth,
- ground snow load: 3 kPa,
- basic snow load coefficient: 0.6,
- roof loads are carried to the exterior wall,
- dead loads:

roof	0.50 kPa
floor	0.47 kPa
wall (with siding)	0.32 kPa
wall (with masonry veneer)	1.94 kPa
foundation wall	0.27 kPa
partitions	0.20 kPa

A-9.15.3.4.(2) Footing Sizes.

The footing sizes in Table 9.15.3.4. are based on typical construction consisting of a roof, not more than 3 storeys, and centre bearing walls or beams. For this reason, Clause 9.15.3.3.(1)(b) stipulates a maximum supported joist span of 4.9 m.

It has become common to use flat wood trusses or wood I-joists to span greater distances in floors of small buildings. Where these spans exceed 4.9 m, minimum footing sizes may be based on the following method:

(a) Determine for each storey the span of joists that will be supported on a given footing. Sum these lengths (sum_1).
(b) Determine the product of the number of storeys times 4.9 m (sum_2).
(c) Determine the ratio of sum_1, to sum_2.
(d) Multiply this ratio by the minimum footing sizes in Table 9.15.3.4. to get the required minimum footing size.

Example: A 2-storey house is built using wood I-joists spanning 6 m.

(a) $sum_1 = 6 + 6 = 12$ m
(b) $sum_2 = 4.9 \times 2 = 9.8$ m
(c) ratio $sum_1/sum_2 = 12/9.8 = 1.22$
(d) required minimum footing size = 1.22 x 350 mm (minimum footing size provided in Table 9.15.3.4.) = 427 mm.

A-9.16.4.3.(1) Thickness.

Depressions and ridges often develop at the soil surface or granular base from construction activity prior to the placement of a concrete slab. Allowances for such irregularities in the base must be recognized. A maximum tolerance of -10 mm is permitted provided the minimum slab thickness at any point is not less than 65 mm and the mean thickness of the concrete slab (exclusive of topping) is 75 mm, as shown in Figure A-9.16.4.3.(1).

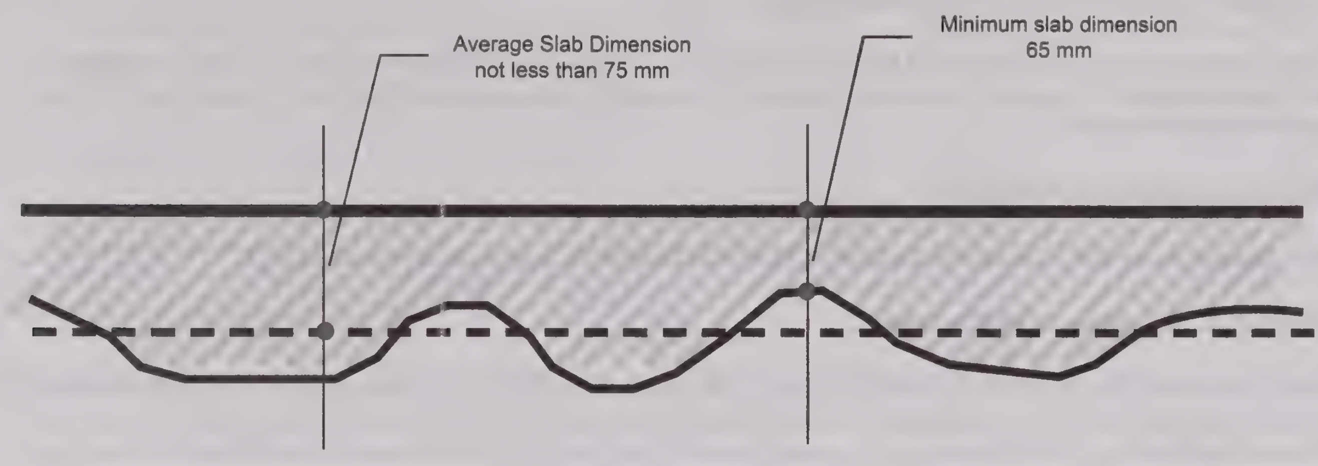


Figure A-9.16.4.3.(1)
Mean Thickness of Concrete Slabs

A-9.17.2.2.(2) Lateral Support of Columns.

Because the Building Code does not provide prescriptive criteria to describe the minimum required lateral support, structures are limited to those that have demonstrated effective performance over time and those that are designed according to Part 4. Verandas on early 20th century homes provide one example of structures whose floor and roof are typically tied to the rest of the building to provide effective lateral support. Large decks set on tall columns, however, are likely to require additional lateral support even where they are connected to the building on one side.

A-9.17.3.4. Design of Steel Columns.

The permitted live floor loads of 2.4 kPa and the spans described for steel beams, wood beams and floor joists are such that the load on columns could exceed 36 kN, the maximum allowable load on columns prescribed in CAN/CGSB-7.2, "Adjustable Steel Columns". In the context of Part 9, loads on columns are calculated from the supported area times the live load per unit area, using the supported length of joists and beams. The supported length is half of the joist spans on each side of the beam and half the beam span on each side of the column.

Dead load is not included based on the assumption that the maximum live load will not be applied over the whole floor. Designs according to Part 4 must consider all applied loads.

A-9.18.7.1.(3) Protection of Ground Cover in Warm Air Plenums.

The purpose of the requirement is to protect combustible ground cover from smoldering cigarette butts that may drop through air registers. The protective material should extend beyond the opening of the register and have up-turned edges, as a butt may be deflected sideways as it falls.

A-9.19.1.1.(1) Venting of Attic and Roof Spaces.

Controlling the flow of moisture by air leakage and vapour diffusion into roof and attic spaces is necessary to limit moisture-induced deterioration. Given that imperfections normally exist in the vapour barriers and air barrier systems, recent research indicates that venting of roof and attic spaces is generally still required. The exception provided in Article 9.19.1.1. recognizes that some specialized ceiling-roof assemblies, such as those used in some factory-built buildings, have, over time, demonstrated that their construction is sufficiently tight to prevent excessive moisture accumulation. In these cases, ventilation would not be required.

A-9.19.2.1.(2) Attic Access Openings.

The dimensions for attic access as provided for in the Building Code are minimum dimensions. Where a fuel fired appliance is to be located in the attic, a larger attic access opening shall be provided in conformance with the Gas Utilization Code or other applicable installation code.

A-9.20.1.2. Seismic Zones.

Information on seismic zones for various localities can be found in MMAH Supplementary Standard SB-1.

A-9.20.5.1.(1) Masonry Support.

Masonry veneer must be supported on a stable structure in order to avoid cracking of the masonry due to differential movement relative to parts of the support. Wood framing is not normally used as a support for the weight of masonry veneer because of its shrinkage characteristics. Where the weight of masonry veneer is supported on a wood structure, as is the case for the preserved wood foundations referred to in Sentence 9.20.5.1.(1) for example, measures must be taken to ensure that any differential movement that may be harmful to the performance of masonry is minimized or accommodated. The general principle stated in Article 9.4.1.1., however, makes it possible to support the weight of masonry veneer on wood framing, provided that engineering design principles prescribed in Part 4 are followed to ensure that the rigidity of the support is compatible with the stiffness of the masonry being supported and that differential movements between the support and masonry are accommodated.

A-Table 9.20.5.2.C. Steel Beams Supporting Masonry Veneer.

Design Assumptions

1. Density of Veneer:
   - Brick = 18.9 kN/m^3
   - Limestone or Sandstone = 22.62 kN/m^3

2. Dead Load of Veneer:
   - 70 mm Brick = 0.070 x 18.9 = 1.32 kPa
   - 89 mm Brick = 0.089 x 18.9 = 1.68 kPa
   - 100 mm Stone = 0.10 x 22.62 = 2.26 kPa

3. Design Standards:
   - CSA S304.1-94, "Masonry Design for Buildings (Limit States Design)"
   - CSA S16.1-94, "Limit States Design of Steel Structures"

4. Design Assumptions - Steel Angles in Table 9.20.5.2.B.:
   - For angle sizes (150 x 90 x 10; 150 x 90 x 13; 150 x 100 x 13; 180 x 100 x 10; 180 x 100 x 13)
   - Mid-span deflection limited to span/700 as per Note (6) of Table 9.20.5.2.A. in the Building Code.
   - Arch action of the brick veneer is assumed, which means that all brick weight within a 45 degree angle of the edge of the opening is not considered in the design of the lintel.
   - The steel yield strength is 300 MPa.

5. Design Assumptions - Steel Wide Flange Beams in Table 9.20.5.2.C.:
    - Mid-span deflection limited to span/700 as per Note (6) of Table 9.20.5.2.A in the Building Code for the brick load only.
    - Mid-span deflection limited to span/600 as per Clause 6.3.5.1 of CSA S304.1 for brick weight plus roof live load (see below).
    - Arch action of the brick veneer is assumed, which means that all brick weight within a 45 degree angle of the edge of the opening is not considered in the design of the lintel.
    - The beam is designed for a roof live load of 2.3 kN/m. This is to account for the fact that the steel beam will typically support a wood stud wall and a gable truss or outlook rafters as well as the brick veneer.
    - The beam is considered to be laterally unsupported along its length since it does not support a floor.
    - The beam is supported by steel columns at each end.
    - The steel yield strength is 300 MPa.

A-9.20.8.5. Distance from Edge of Masonry to Edge of Supporting Members.

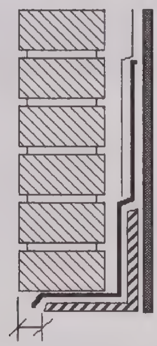


Figure A-9.20.8.5.
Maximum Projection of Masonry Beyond its Support

A-9.20.12.2.(2) Corbelling of Masonry Foundation Walls.

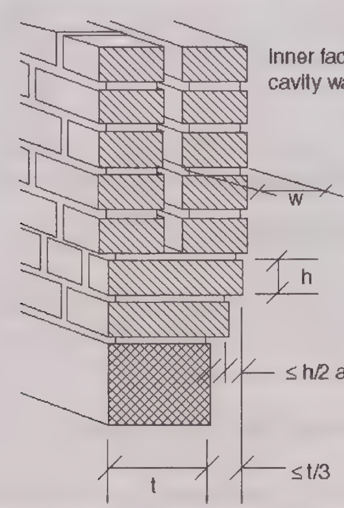


Figure A-9.20.12.2.(2)
Maximum Corbel Dimensions

A-9.20.13.9.(3) Dampproofing of Masonry Walls.

The reason for installing sheathing paper behind masonry walls is to prevent rainwater from reaching the interior finish if it should leak past the masonry. The sheathing paper intercepts the rainwater and leads it to the bottom of the wall where the flashing directs it to the exterior via weep holes. If the insulation is a type that effectively resists the penetration of water, and is installed so that water will not collect behind it, then there is no need for sheathing paper. If water that runs down between the masonry and the insulation is able to leak out at the joints in the insulation, such insulation will not act as a substitute for sheathing paper. If water cannot leak through the joints in the insulation but collects in cavities between the masonry and insulation, subsequent freezing could damage the wall. Where sheathing paper is not used, therefore, the adhesive or mortar should be applied to form a continuous bond between the masonry and the insulation. If this is not practicable because of an irregular masonry surface, then sheathing paper is necessary.

A-9.21.1.2.(1) Factory-Built Chimneys.

Certain solid-fuel burning appliances may be connected to factory-built chimneys other than those specified in Sentence 9.21.1.2.(1) if tests show that the use of such a chimney will provide an equivalent level of safety, as an alternative solution pursuant to Section 2.1. of Division C.

A-9.21.3.6.(2) Metal Chimney Liners.

Masonry chimneys with metal liners may be permitted to serve solid-fuel burning appliances if tests show that such liners will provide an equivalent level of safety, as an alternative solution pursuant to Section 2.1. of Division C.

A-9.21.4.4.(1) Location of Chimney Top.

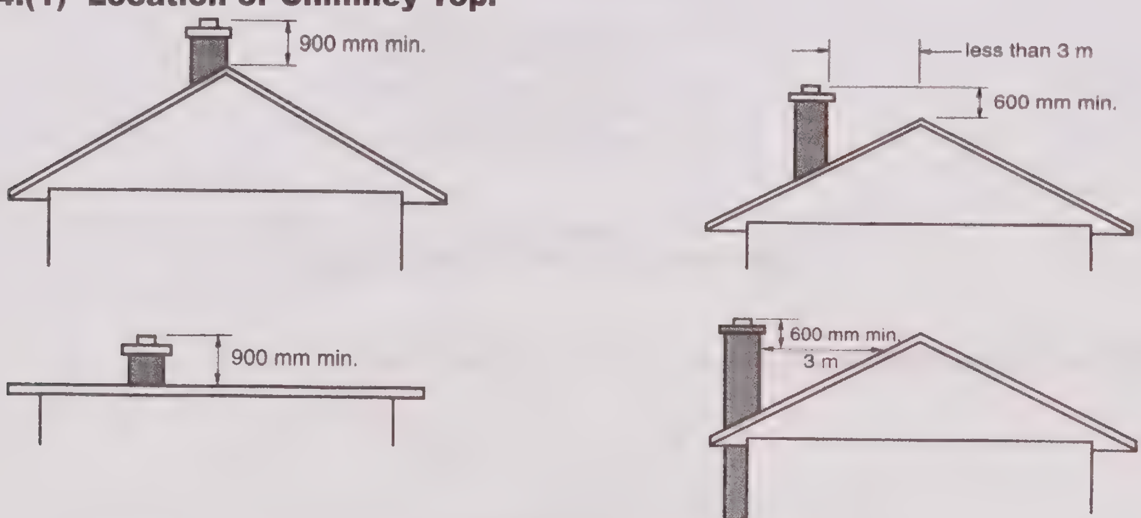


Figure A-9.21.4.4.(1)
Vertical and Horizontal Distance from Chimney Top to Roof

A-9.21.4.5.(2) Lateral Support for Chimneys.

Where a chimney is fastened to the house framing with metal anchors, in accordance with CAN/CSA-A370, "Connectors for Masonry", it is considered to have adequate lateral support. The portion of the chimney stack above the roof is considered as free standing and may require additional lateral support.

A-9.21.5.1.(1) Clearance from Combustible Materials.

For purposes of this Sentence, an exterior chimney can be considered to be one which has at least one surface exposed to the outside atmosphere or unheated space over the majority of its height. All other chimneys should be considered to be interior.

A-9.23.1.1. Structural Framing Systems Other than Light Wood-Frame Construction.

The prescriptive requirements in Section 9.23. apply only to standard light wood-frame construction. Other structural framing systems, such as post, beam and plank construction, plank frame wall construction, and log construction must be designed in accordance with Part 4.

A-9.23.1.1.(1) Application of Section 9.23.

In previous editions of the Code, Sentence 9.23.1.1.(1) referred to "conventional" wood-frame construction. Over time, conventions have changed and the application of Part 9 has expanded.

The prescriptive requirements provided in Section 9.23. still focus on lumber beams, joists, studs and rafters as the main structural elements of "wood-frame construction". The requirements recognize - and have recognized for some time - that walls and floors may be supported by components made of material other than lumber; for example, by foundations described in Section 9.15. or by steel beams described in Article 9.23.4.3. These components still fall within the general category of wood-frame construction.

With more recent innovations, alternative structural components are being incorporated into wood-frame buildings. Wood I-joists, for example, are very common. Where these components are used in lieu of lumber, the requirements in Section 9.23. that specifically apply to lumber joists do not apply to these components: for example, limits on spans and acceptable locations for notches and holes. However, requirements regarding the fastening of floor sheathing to floor joists still apply, and the use of wood I-joists does not affect the requirements for wall or roof framing.

Similarly, if steel floor joists are used in lieu of lumber joists, the requirements regarding wall or roof framing are not affected.

Conversely, Sentence 9.23.1.1.(1) precludes the installation of pre-cast concrete floors on wood-frame walls since these are not "generally comprised of ... small repetitive structural members ... spaced not more than 610 mm o.c."

Thus, the reference to "engineered components" in Sentence 9.23.1.1.(1) is intended to indicate that, where an engineered product is used in lieu of lumber for one part of the building, this does not preclude the application of the remainder of Section 9.23. to the structure, provided the limits to application with respect to cladding, sheathing or bracing, spacing of framing members, supported loads and maximum spans are respected.

A-9.23.3.1.(2) Standard for Screws.

The requirement that wood screws conform to ANSI/ASME B18.6.1., "Wood Screws (Inch Series)" is not intended to preclude the use of Robertson head screws. The requirement is intended to specify the mechanical properties of the fastener, not to restrict the means of driving the fastener.

A-9.23.3.3.(1) Prevention of Splitting.

The intent of the phrase "staggering the nails in the direction of the grain" is illustrated in Figure A-9.23.3.3.(1).

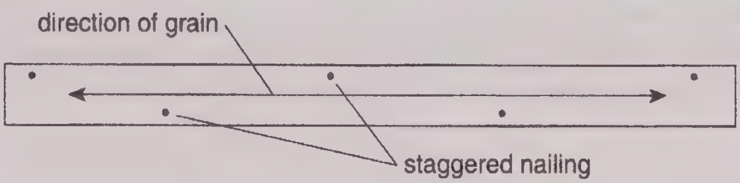


Figure A-9.23.3.3.(1)
Staggered Nailing

A-9.23.4.2. Span Tables for Wood Joists, Rafters and Beams.

In these span tables the term "rafter" refers to a sloping wood framing member which supports the roof sheathing and encloses an attic space but does not support a ceiling. The term "roof joist" refers to a horizontal or sloping wood framing member that supports the roof sheathing and the ceiling finish but does not enclose an attic space. Where rafters or roof joists are intended for use in a locality having a higher specified roof snow load than shown in the tables, the maximum member spacing may be calculated as the product of the member spacing and specified snow load shown in the span tables divided by the specified snow load for the locality being considered. The following examples show how this principle can be applied:

(a) For a 3.5 kPa specified snow load, use spans for 2.5 kPa and 610 mm o.c. spacing but space members 406 mm o.c.
(b) For a 4.0 kPa specified snow load, use spans for 2.0 kPa and 610 mm o.c. spacing but space members 305 mm o.c.

The maximum spans in the span tables are measured from the inside face or edge of support to the inside face or edge of support.

In the case of sloping roof framing members, the spans are expressed in terms of the horizontal distance between supports rather than the length of the sloping member. The snow loads are also expressed in terms of the horizontal projection of the sloping roof. Spans for odd size lumber may be estimated by straight line interpolation in the tables.

These span tables may be used where members support a uniform live load only. Where the members are required to be designed to support a concentrated load, they must be designed in conformance with Subsection 4.3.1.

Supported joist length in Tables A-8, A-9 and A-10 means half the sum of the joist spans on both sides of the beam. For supported joist lengths between those shown in the tables, straight line interpolation may be used in determining the maximum beam span.

Tables A-1 to A-16 cover only the most common configurations. Especially in the area of floors, a wide variety of other configurations is possible: glued subfloors, concrete toppings, machine stress rated lumber, etc. The Canadian Wood Council publishes "The Span Book", a compilation of span tables covering many of these alternative configurations. Although these tables have not been subject to the formal committee review process, the Canadian Wood Council generates, these span tables for wood structural components; thus Building Code users can be confident that the alternative span tables in "The Span Book" are consistent with the span tables in the Building Code and with relevant Building Code requirements.

Spans for wood joists, rafters and beams which fall outside the scope of these tables, including those for U.S. species and individual species not marketed in the commercial species combinations described in the span tables, can be calculated in conformance with CSA O86.1, "Engineering Design in Wood".

A-9.23.4.2.(2) Numerical Method to Establish Vibration-Controlled Spans for Wood Frame Floors.

In addition to the normal strength and deflection analyses, the calculations on which the floor joist span tables are based include a method of ensuring that the spans are not so long that floor vibrations could lead to occupants perceiving the floors as too "bouncy" or "springy". Limiting deflection under the normal uniformly distributed loads to 1/360 of the span does not provide this assurance. Normally, vibration analysis requires detailed dynamic modelling. However, the calculations for the span tables use the following simplified static analysis method of estimating vibration-acceptable spans:

- The span which will result in a 2 mm deflection of a single joist supporting a 1 kN concentrated midpoint load is calculated.
- This span is multiplied by a factor, K, to determine the "vibration-controlled" span for the entire floor system. If this span is less than the strength- or deflection-controlled span under uniformly distributed load, the vibration-controlled span becomes the maximum span.

- The K factor is determined from the following relationship:

$$\ln(K) = A - B \bullet \ln(S_i/S_{184}) + G$$

where

A, B = constants, the values of which are determined from Tables A-9.23.4.2.(2)A. or B.

G = constant, the value of which is determined from Table A-9.23.4.2.(2)C.

S_i = span which results in a 2 mm deflection of the joist in question under a 1 kN concentrated midpoint load

S_{184} = span which results in a 2 mm deflection of a 38 x 184 mm joist of same species and grade as the joist in question under a 1 kN concentrated midpoint load.

For a given joist species and grade, the value of K shall not be greater than K_3, the value which results in a vibration- controlled span of exactly 3 m. This means that for vibration-controlled spans 3 m or less, K always equals K_3, and for vibration-controlled spans greater than 3 m, K is as calculated.

Note that, for a sawn lumber joist, the ratio S_i/S_{184} is equivalent to its depth (mm) divided by 184.

Due to rounding differences, the method, as presented here, might produce results slightly different from those produced by the computer program used to generate the span tables.

Additional background information on this method can be found in the following publications:

- Onysko, D.M. Serviceability Criteria for Residential Floors Based on a Field Study of Consumer Response. Project 03-50-10-008. Forintek Canada Corp., Ottawa, Canada 1985.
- Onysko, D.M. Performance Criteria for Residential Floors Based on Consumer Responses. 1988 International Conference on Timber Engineering, Seattle, September 19-22, Forest Products Research Society, Vol.1, 1988, pp. 736-745.
- Onysko, D.M. Performance and Acceptability of Wood Floors - Forintek Studies. Proceedings of Symposium/Workshop on Serviceability of Buildings, Ottawa, May 16-18, National Research Council of Canada, Ottawa, 1988.

Table A-9.23.4.2.(2)A.
Constants A and B for Calculating Vibration-Controlled Floor Joist Spans - General Cases

Subfloor Thickness, mm	With Strapping[1]			With Bridging			With Strapping and Bridging		
	Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
	305	406	610	305	406	610	305	406	610
Constant A									
15.5	0.30	0.25	0.20	0.37	0.31	0.25	0.42	0.35	0.28
19.0	0.36	0.30	0.24	0.45	0.37	0.30	0.50	0.42	0.33
Constant B									
	0.33			0.38			0.41		
Column 1	2	3	4	5	6	7	8	9	10

Notes to Table A-9.23.4.2.(2)A.:

(1) Gypsum board attached directly to joists can be considered equivalent to strapping.

Table A-9.23.4.2.(2)B.
Constants A and B for Calculating Vibration-Controlled Floor Joist Spans - Special Cases

Subfloor Thickness, mm	Joists with Ceiling Attached to Wood Furring(1)						Joists with Concrete Topping(2)		
	Without Bridging			With Bridging			With or Without Bridging		
	Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
	305	406	610	305	406	610	305	406	610
Constant A									
15.5	0.39	0.33	0.24	0.49	0.44	0.38	0.58	0.51	0.41
19.0	0.42	0.36	0.27	0.51	0.46	0.40	0.62	0.56	0.47
Constant B									
	0.34			0.37			0.35		
Column 1	2	3	4	5	6	7	8	9	10

Notes to Table A-9.23.4.2.(2)B.:

(1) Wood furring means 19 x 89 mm boards not more than 610 mm o.c., or 19 x 64 mm boards not more than 305 mm o.c. For all other cases, see Table A-9.23.4.2.(2)A.

(2) 30 mm to 51 mm normal weight concrete (not less than 20 MPa) placed directly on the subflooring.

Table A-9.23.4.2.(2)C.
Constant G for Calculating Vibration-Controlled Floor Joist Spans

Floor Description	Constant G
Floors with nailed(1) subfloor	0.00
Floor with nailed and field-glued(2) subfloor, vibration-controlled span greater than 3 m	0.10
Floor with nailed and field-glued(2) subfloor, vibration-controlled span 3 m or less	0.15
Column 1	2

Notes to Table A-9.23.4.2.(2)C.:

(1) Common wire nails, spiral nails or wood screws can be considered equivalent for this purpose.

(2) Subfloor field-glued to floor joists with elastomeric adhesive complying with standard CAN/CGSB-71.26-M, "Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems".

A-9.23.4.3.(1) Maximum Spans for Steel Beams Supporting Floors in Dwellings.

A beam may be considered to be laterally supported if wood joists bear on its top flange at intervals of 610 mm or less over its entire length, if all the load being applied to this beam is transmitted through the joists and if 19 mm by 38 mm wood strips in contact with the top flange are nailed on both sides of the beam to the bottom of the joists supported. Other additional methods of positive lateral support are acceptable.

For supported joist lengths intermediate between those in the table, straight line interpolation may be used in determining the maximum beam span.

Design Assumptions for Tables A-20 to A-29 (Steel Beams Supporting Roofs and Floors)

1. Density of Brick Veneer:
   - Brick = 18.9 kN/m^3

2. Dead Load of Brick Veneer:
   - 89 mm Brick = 0.089 x 18.9 = 1.68 kPa
   - Brick loading on beam = 3 m high brick x 1.68 = 5.04 kN/m. This is based on a single storey wall with windows and a brick gable above the top of the stud wall. In this case, the windows in the exterior wall nullify the arch action of the brick and the load is applied uniformly along the length of the beam.

3. Dead Load of Structure:
   - Roof = 0.62 kPa (Asphalt shingle roof)
   - Floor = 1.5 kPa as per Appendix Note A-Table 9.23.4.3.

4. Live Loads:
   - Floor = 1.9 kPa
   - Roof = as indicated in the Tables

5. Design Standards:
   - CSA S304.1-94, "Masonry Design for Buildings (Limit States Design)"
   - CSA S16.1-94, 'Limit States Design of Steel Structures"

6. Design Assumptions:
   - Simply supported beam spans
   - Laterally supported top flange
   - Yield strength 300 MPa
   - Mid-span deflection limited to span/600 as per Clause 6.3.5.1 of CSA S304.1, for brick weight plus live load. The self-weight of structure is typically on the beam prior to the application of the brick so the deflection check need only include live and brick loads.
   - For siding walls the mid-span deflection is limited to span/360 on live load.

A-Table 9.23.4.3. Spans for Steel Beams.

The spans provided in Table 9.23.4.3. reflect a balance of engineering and acceptable proven performance. The spans have been calculated based on the following assumptions:

- Simply supported beam spans
- Laterally supported top flange
- Yield strength 350 MPa
- Deflection limit L/360
- Live load = 1.9 kPa
- Dead load 1.5 kPa.

The calculation used to establish the specified maximum beam spans also applies a revised live load reduction factor to account for the lower probability of a full live load being applied over the supported area in Part 9 buildings.

A-9.23.4.4. Concrete Topping.

Vibration- controlled spans given in Table A-2 for concrete topping are based on a partial composite action between the concrete, subflooring and joists. Normal weight concrete having a compressive strength of not less than 20 MPa, placed directly on the subflooring, provides extra stiffness and results in increased capacity. The use of a bond breaker between the topping and the subflooring, or the use of lightweight concrete topping limits the composite effects.

Where either a bond breaker or lightweight topping is used, Table A-1 may be used but the additional dead load imposed by the concrete must be considered. The addition of 51 mm of concrete topping can impose an added load of 0.8 to 1.2 kPa, depending on the density of the concrete.

Example:

Assumptions:
- basic dead load = 0.5 kPa
- topping dead load = 0.8 kPa
- total dead load = 1.3 kPa
- live load = 1.9 kPa
- vibration limit: per A-9.23.4.2.(2)
- deflection limit = 1/360
- ceiling attached directly to joists, no bridging

The spacing of joists in the span tables can be conservatively adjusted to allow for the increased load by using the spans in Table A-1 for 610 mm spacing, but spacing the joists 406 mm apart. Similarly, floor beam span tables can be adjusted by using 4.8 m supported length spans for cases where the supported length equals 3.6 m.

A-9.23.8.3. Joint Location in Built-Up Beams.

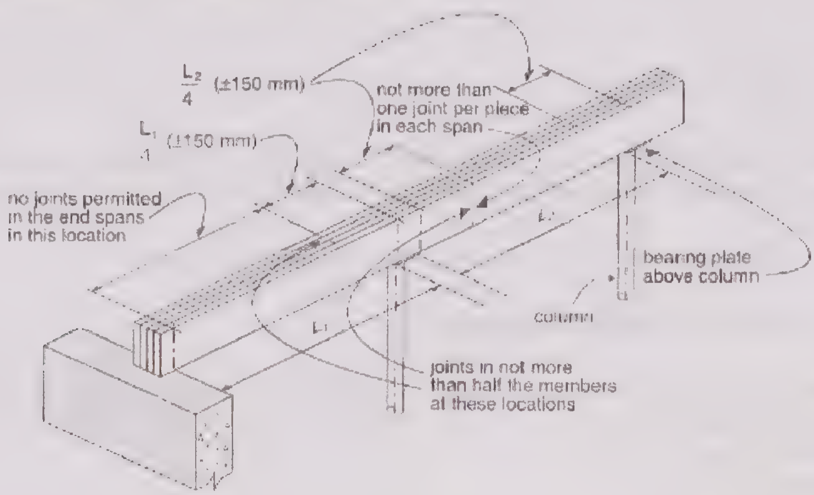


Figure A-9.23.8.3.
Joint Location in Built-up Beams

A-9.23.10.1.(2) Tall Stud Walls.

Design Assumptions for Tables A-30 to A-33.

1. Roof dead load is 0.5 kPa (asphalt shingle roof) as per rafter and lintel tables in the Building Code.

2. Specified roof snow load is the factored load incorporating rain load as per the rafter, header and lintel spans in the Building Code.

3. Wind loads are based on wind loads in the 2006 Building Code and the 2005 edition of the NBC as adopted in the *Engineering Guide for Wood Frame Construction* published by the Canadian Wood Council
   a. Basic wind pressure is the 1 in 50 year pressure found in Table 1.2 of MMAH Supplementary Standard SB-1
   b. C_e = 0.7 as per Sentence 4.1.7.1.(5)(b) in the Building Code
   c. C_pC_g = –2.1 for ultimate limit state for wind acting alone
   d. C_pC_g = –1.75 for the serviceability limit state
   e. C_pC_g = 1.5 for wind acting in combination with gravity loads

f. C_{pi} varied from –0.45 to 0.3 as per *User's Guide - NBC 2005, Structural Commentaries (Part 4 of Division B)*. Where external wind was a pressure (wind acting in combination with axial loads) the internal wind suction coefficient of –0.45 was used. Where external wind was suction (wind acting alone) the internal wind pressure coefficient of 0.3 was used.
g. C_{gi} = 2.0 as per Sentence 4.1.7.1.(6)(c) in the 2006 Building Code.
h. The importance factors used to calculate wind loads were 1.0 at the ultimate limit state and 0.75 at the serviceability limit state as per Table 4.1.7.1. in the 2006 Building Code.

4. Ultimate Limit State loads cases were in accordance with Table 4.1.3.2. in the 2006 Building Code.
   a. 1.4 axial dead load
   b. 1.25 axial dead load + 1.5 axial snow load
   c. 1.25 axial dead load + 1.5 axial snow load + 0.4 lateral wind load
   d. 1.25 axial dead load + 0.5 axial snow load + 1.4 lateral wind load
   e. 1.4 lateral wind load

5. Serviceability Limits States, based on the *Engineering Guide for Wood Frame Construction*, were calculated using specified lateral wind loads, and included:
   a. Deflection limit of stud length/180 for walls with siding, and
   b. Deflection limit of stud length/360 for walls with brick cladding.

6. Stud resistance was calculated as per CSA O86 and adopted for the *Engineering Guide for Wood Frame Construction*
   a. The system factors used were Case 2 load-sharing for bending moment resistance and Case 1 for compression resistance parallel to grain.
   b. A load duration factor of 1.25 was used where lateral wind acted alone or in combination with axial loads.

7. Fastening requirements are based on the short-term nail resistance values given in CSA O86-01.

A-9.23.10.2. Bracing.

Traditionally, diagonal bracing has been provided at the corners of wood framed walls to provide resistance against wind racking forces. Laboratory tests have indicated, however, that the bracing that had been traditionally used contributed relatively little to the overall strength of the wall. Most of the racking resistance was in effect provided by the interior finish. Because of this, the requirements for bracing were deleted in the late 1950's. (See "Shear Resistance of Wood Frame Walls", by A.T. Hansen, Building Practice Note 61, Institute for Research in Construction, National Research Council, Ottawa.)

Where the interior is not finished, however, bracing is necessary if the siding itself or the sheathing does not provide the required racking strength. If panel type siding is used, or if the sheathing consists of plywood, OSB, waferboard, gypsum board, diagonal lumber, or fibreboard sheathing, additional bracing is not considered necessary because of the wind bracing provided by these materials. Where bracing is provided, it must be installed at roughly a 45° angle on each wall and in each storey, extending the full height of the storey. This type of bracing provides considerably greater resistance to wind forces than the traditional bracing, which was found to be relatively ineffective. The permission to omit bracing assumes typical house designs. Some buildings may have reduced resistance to racking forces as a result of their configuration. These include tall narrow buildings in exposed locations with large door or window openings located in the short sides. In such cases, racking resistance can be improved by ensuring that paneled sections are placed adjacent to the openings. The Code does not address the issue of bracing of the structure during construction. It is often necessary to provide temporary bracing until the interior finish or sheathing is installed; however, this is not a Code requirement.

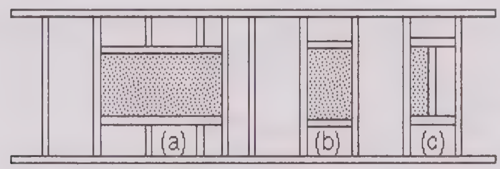
A-9.23.10.4.(1) Fingerjoined Lumber.

The NLGA "Standard Grading Rules for Canadian Lumber", referenced in Article 9.3.2.1. refers to two special product standards, SPS-1,"Fingerjoined Structural Lumber," and SPS-3, "Fingerjoined Stud Lumber - Vertical Use Only", produced by NLGA. Material identified as conforming to these standards is considered to meet the requirements in this Sentence for joining with a structural adhesive. Lumber fingerjoined in accordance with SPS-3 should be used as a vertical end-loaded member in compression only, where sustained bending or tension-loading conditions are not present, and where the moisture content of the wood will not exceed 19%. Fingerjoined lumber may not be visually regraded or remanufactured into a higher stress grade even if the quality of the lumber containing fingerjoints would otherwise warrant such regrading.

A-9.23.10.6.(2) Single Studs at Sides of Openings.

Configurations which comply

(a) full height studs both sides
(b) full height studs both sides and opening within stud space
(c) opening within stud space



Configurations which do not comply

(a) opening wider than stud space without full height studs both sides
(b) opening narrower than but not within stud space

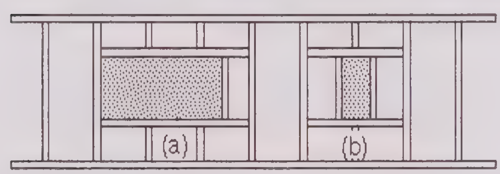


Figure A-9.23.10.6.(2)A.
Single Studs at Openings in Non-loadbearing Interior Walls

Configurations which comply

(a), (b), (c) openings all narrower than and within stud space;
no two full stud space width openings in adjacent stud spaces

Configurations which do not comply

(a) opening wider than stud space
(b) opening narrower than but not within stud space
(c) two openings, full stud space width, in adjacent stud spaces

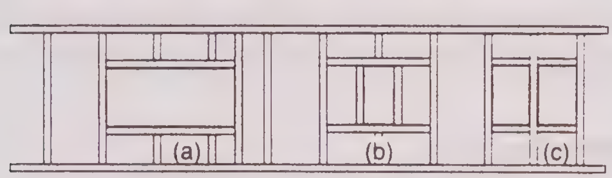


Figure A-9.23.10.6.(2)B.
Single Studs at Openings in All Other Walls

A-9.23.10.7.(2) Stud Posts Supporting Girder Trusses and Beams

Design Assumptions

1. Roof Load = 0.62 kPa (Asphalt shingle roof)

2. Design Standards: CSA 086-01, "Engineering Design in Wood"

3. Design Assumptions:
   - The studs are braced from buckling about their weak axis by the attachment of the wall sheathing.
   - The post is designed for axial loading applied at the centre of the stud cross-section (concentric loading).
   - Stud grade material has been assumed.
   - The stud resistance is based on the compressive resistance parallel to grain (P_r) and the bearing resistance of the wall plate (Q_r).
   - In the calculation of P_r, a system factor (K_H) of 1.0 was used.
   - In the calculation of Q_r, a size factor (K_{zcp}) of 1.15 was used since the wall plate width is greater than two times the thickness. A length of bearing factor (K_B) of 1.0 was used since the stud post can occur at a splice in the wall plate.
   - The post size has been limited to 5 plies.
   - The post size is maintained through all storeys directly below the girder truss or beam until the load is transferred to the foundation wall.

A-9.23.13.11.(2) Wood Roof Truss Connections.

Sentence 9.23.13.11.(2) requires that the connections used in wood roof trusses be designed in conformance with Subsection 4.3.1. The designer of wood trusses should be skilled in the work concerned, since wood roof trusses are complex structures which depend on a number of components (chord members, web members, cross-bracing, connectors) working together to function safely. This complexity precludes the standardization of truss design into tables comprehensive enough to satisfy the variety of roof designs required by the housing industry.

A-9.23.14.2.(4) Water Absorption Test.

A method for determining water absorption is described in ASTM D1037, "Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials". The treatment to reduce water absorption may be considered to be acceptable if a 300 mm x 300 mm sample when treated on all sides and edges does not increase in weight by more than 6% when tested in the horizontal position.

A-9.23.14.4.(2) OSB.

CSA 0437.0, "OSB and Waferboard", requires that Type O (aligned or oriented) panels be marked to show the grade and the direction of face alignment.

A-9.24.3.2.(3) Framing Above Doors in Steel Stud Fire Separations.

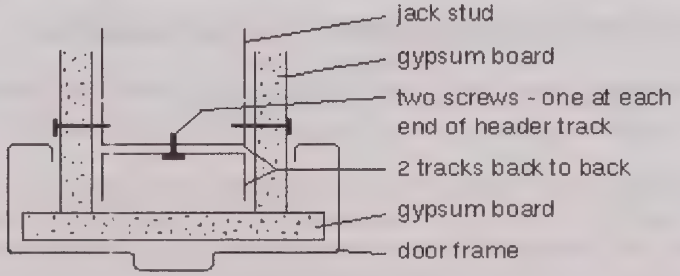


Figure A-9.24.3.2.(3)
Steel Stud Header Detail

A-9.25.2.2.(2) Flame-Spread Ratings of Insulating Materials.

Part 9 has no requirements for flame-spread ratings of insulation materials since these are seldom exposed in parts of buildings where fires are likely to start. Certain of the insulating material standards referenced in Sentence 9.25.2.2.(1) do include flame-spread rating criteria. These are included either because the industry producing the product wishes to demonstrate that their product does not constitute a fire hazard or because the product is regulated by authorities other than building authorities (e.g., Hazardous Products Act). However, the Code cannot apply such requirements to some materials and not to others. Hence, these flame-spread rating requirements are excepted in referencing these standards.

A-9.25.2.3.(3) Position of Insulation.

For thermal insulation to be effective, it must not be short-circuited by convective air flow through or around the material. If low density fibrous insulation is installed with an air space on both sides of the insulation, the temperature differential between the warm and cold sides will drive convective air flow around the insulation. If foam plastic insulation is spot adhered to a back-up wall or adhered in a grid pattern to an air permeable substrate, and is not sealed at the joints and around the perimeter, air spaces between the insulation and the substrate will interconnect with spaces behind the cladding. Any temperature or air pressure differential across the insulation will again lead to short circuiting of the insulation by air flow. Thermal insulation must therefore be installed in full and continuous contact with the air barrier or another continuous component with low air permeance. (See Appendix note A-9.25.5.1.(1) for examples of low-air-permeance materials.)

A-9.25.2.4.(3) Loose-Fill Insulation in Existing Wood Frame Walls.

The addition of insulation into exterior walls of existing wood frame buildings increases the likelihood of damage to framing and cladding components as a result of moisture accumulation. Many older homes were constructed with little or no regard for protection from vapour transmission or air leakage from the interior. Adding thermal insulation will substantially reduce the temperature of the siding or sheathing in winter months, possibly leading to condensation of moisture at this location.

Defects in exterior cladding, flashing and caulking could result in rain entering the wall cavity. This moisture, if retained by the added insulation, could initiate the process of decay.

Steps should be taken therefore, to minimize these effects prior to the retrofit of any insulation. Any openings in walls that could permit leakage of interior heated air into the wall cavity should be sealed. The inside surface should be coated with a low-permeability paint to reduce moisture transfer by diffusion. Finally, the exterior siding, flashing and caulking should be checked and repaired if necessary to prevent rain penetration.

A-9.25.2.4.(5) Loose-Fill Insulation in Masonry Walls.

Typical masonry cavity wall construction techniques do not lend themselves to the prevention of entry of rainwater into the wall space. For this reason, loose-fill insulation used in such space must be of the water repellent type. A test for water-repellency of loose-fill insulation suitable for installation in masonry cavity walls can be found in ASTM C516, "Vermiculite Loose Fill Insulation".

A-9.25.3.1.(1) Air Barrier Systems for Control of Condensation.

The majority of moisture problems resulting from condensation of water vapour in walls and ceiling/attic spaces are caused by the leakage of moist interior heated air into these spaces rather than by the diffusion of water vapour through the building envelope.

Protection against such air leakage must be provided by a system of air-impermeable materials joined with leak-free joints. Generally, air leakage protection can be provided by the use of air-impermeable sheet materials, such as gypsum board or polyethylene of sufficient thickness, when installed with appropriate structural support. However, the integrity of the airtight elements in the air barrier system can be compromised at the joints and here special care must be taken in design and construction to achieve an effective air barrier system.

Although Section 9.25. refers separately to vapour barriers and airtight elements in the air barrier system, these functions in a wall or ceiling assembly of conventional wood frame construction are often combined as a single membrane which acts as a

barrier against moisture diffusion and the movement of interior air into insulated wall or roof cavities. Openings cut through this membrane, such as for electrical boxes, provide opportunities for air leakage into concealed spaces, and special measures must be taken to make such openings as airtight as possible. Attention must also be paid to less obvious leakage paths, such as holes for electric wiring, plumbing installations, wall-ceiling and wall-floor intersections, and gaps created by shrinkage of framing members.

In any case, air leakage must be controlled to a level where the occurrence of condensation will be sufficiently rare, or the quantities accumulated sufficiently small, and drying sufficiently rapid, to avoid material deterioration and the growth of mould and fungi.

Generally the location in a building assembly of the airtight element of the air barrier system is not critical; it can restrict air leakage whether it is located near the outer surface of the assembly, near the inner surface or at some intermediate location. However, if a material chosen to act as an airtight element in the air barrier system also has the characteristics of a vapour barrier (i.e., low permeability to water vapour), its location must be chosen more carefully in order to avoid moisture problems. (See Appendix Notes A-9.25.4.3.(2) and A-9.25.5.1.(1)).

In some assemblies, an airtight element in the air barrier system is the interior finish, such as gypsum board, which is sealed to framing members and adjacent components by gaskets, caulking, tape or other methods to complete the air barrier system. In such cases, special care in sealing joints in a separate vapour barrier is not critical. This approach often uses no separate vapour barrier but relies on appropriate paint coatings to give the interior finish sufficient resistance to water vapour diffusion that it can provide the required vapour diffusion protection.

Section 9.25. allows for such innovative techniques, as well as the more traditional approach of using a continuous sheet, such as polyethylene, to act as an "air/vapour barrier".

Further information is available in "Moisture Problems in Houses", by A.T. Hansen, Canadian Building Digest 231, available from the Institute for Research in Construction, National Research Council of Canada, Ottawa K1A 0R6.

A.9.25.3.3.(15) Air Leakage and Soil Gas Control in Floors-on-Ground.

The requirement in Sentence 9.25.3.3.(15) regarding the sealing of penetrations of the air barrier also applies to hollow metal and masonry columns penetrating the floor slab. Not only the perimeters but also the centres of such columns must be sealed or blocked.

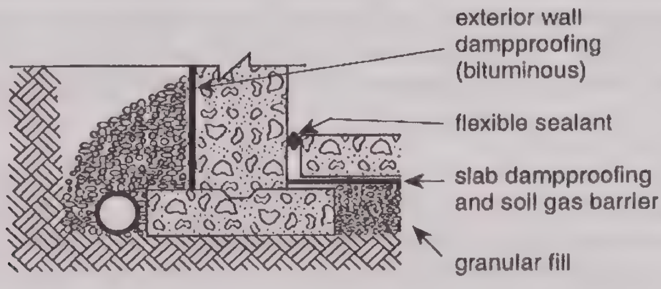


Figure A-9.25.3.3,(15)
Dampproofing and Soil Gas Control at Foundation Wall / Floor Junctions with Solid Walls

A-9.25.4.2.(2) Normal Conditions.

The requirement for a 60 ng/(Pa•s•m²) vapour barrier stated in Sentence 9.25.4.2.(1) is based on the assumption that the building assembly is subjected to conditions that are considered normal for typical residential occupancies, and business and personal services occupancies. However, where the intended use of an occupancy includes facilities or activities that will generate a substantial amount of moisture indoors during the heating season, such as swimming pools, greenhouses, laundromats, and any continuous operation of hot tubs and saunas, the building envelope assemblies would have to demonstrate acceptable performance levels in accordance with the requirements in Part 5.

A-9.25.4.3.(2) Location of Vapour Barriers.

Assemblies in which the vapour barrier is located partway through the insulation meet the intent of this Article provided it can be shown that the temperature of the vapour barrier will not fall below the dew point of the heated interior air.

A-9.25.5.1. Location of Low Permeance Materials.

Low Air- and Vapour-Permeance Materials and Implications for Moisture Accumulation

The location in a building assembly of a material with low air permeance is not critical; the material can restrict outward movement of indoor air whether it is located near the outer surface of the assembly, near the inner surface, or at some intermediate location, and such restriction of air movement is generally beneficial, whether or not the particular material is designated as part of the air barrier system. However, if such a material also has the characteristics of a vapour barrier (i.e., low permeability to water vapour) and low thermal resistance, its location must be chosen more carefully in order to avoid moisture accumulation.

Any moisture from the indoor air which diffuses through the inner layers of the assembly or is carried by air leakage through those layers may be prevented from diffusing or being transferred through the assembly by a low air- and vapour-permeance material. This moisture transfer will usually not cause a problem if the material is located where the temperature is above the dew point of the indoor air; the water vapour will remain as vapour, the humidity level in the assembly will come to equilibrium with that of the indoor air, further accumulation of moisture will cease or stabilize at a low rate, and no harm will be done.

But if the low air- and vapour-permeance material is located where the temperature is below the dew point of the air at that location, water vapour will condense and accumulate as water or ice, which will reduce the humidity level and encourage the movement of more water vapour into the assembly. If this temperature remains below the dew point for any length of time, significant moisture could accumulate. When warmer weather returns, the presence of a material with low water vapour permeance can retard drying of the accumulated moisture. Moisture which remains into warmer weather can support the growth of decay organisms.

Due consideration should be given to the properties and location of any material in the building envelope, including paints, liquid-applied or sprayed-on and trowelled-on materials. It is recognized that assemblies that include low air- and vapour-permeance materials are acceptable, but only where these materials are not susceptible to damage from moisture or where they can accommodate moisture (for example insulated concrete walls). Further information on the construction of basement walls may be found in

- Performance Guidelines for Basement Envelope Systems and Materials," published by NRC-IRC.
- Best Practice Guide Full-Height Basement Insulation Guide, 2008 published by MMAH

Cladding

Different cladding materials have different vapour permeances and different degrees of susceptibility to moisture deterioration. They are each installed in different ways that are more or less conducive to the release of moisture that may accumulate on the inner surface. Sheet or panel-type cladding materials, such as metal sheet, have a vapour permeance less than 60 ng/(Pa•s•m²). Sheet metal cladding that has lock seams also has a low air leakage characteristic and so must be installed outboard of a drained and vented air space. Assemblies clad with standard residential vinyl or metal strip siding do not require additional protection as the joints are not so tight as to prevent the dissipation of moisture.

Sheathing

Like cladding, sheathing materials have different vapour permeances and different degrees of susceptibility to moisture deterioration.

Low-permeance sheathing may serve as the vapour barrier if it can be shown that the temperature of the interior surface of the sheathing will not fall below that at which saturation will occur. This may be the case where insulating sheathing is used.

Thermal Insulation

Where low-permeance foamed plastic is the sole thermal insulation in a building assembly, the temperature of the inner surface of this element will be close to the interior temperature. If the foamed plastic insulation has a permeance below 60 ng/(Pa•s•m^2), it can fulfill the function of a vapour barrier to control condensation within the assembly due to vapour diffusion. However, where low-permeance thermal insulation is installed on the outside of an insulated frame wall, the temperature of the inner surface of the insulation may fall below the dew point. In this case, a the function of vapour barrier has to be provided by a separate building element installed on the warm side of the assembly.

Normal Conditions

The required minimum ratios given in Table 9.25.5.2. are based on the assumption that the building assembly is subjected to conditions that are considered normal for typical residential occupancies, and business and personal services occupancies. However, where the intended use of an occupancy includes facilities or activities that will generate a substantial amount of moisture indoors during the heating season, such as swimming pools, greenhouses, the operation of a laundromat or any continuous operation of hot tubs and saunas, the building envelope assemblies would have to demonstrate acceptable performance levels in accordance with the requirements in Part 5.

A-9.25.5.1.(1) Air and Vapour Permeance Values.

The air leakage characteristics and water vapour permeance values for a number of colnmon materials are given in Table A-9.25.5.1.(1). These values are provided on a generic basis; proprietary products may have values differing somewhat from those in the Table (consult the manufacturers' current data sheets for their products' values). The values quoted are for the material thickness listed. Water vapour permeance is inversely proportional to thickness: therefore, greater thicknesses will have lower water vapour permeance values.

Table A-9.25.5.1.(1)
Air and Vapour Permeance Values[1]

Material	Air Leakage Characteristic, L/(s•m²) at 75 Pa (Air Permeance)	Water Vapour Permeance, (Dry CuP) 60 ng/(Pa•s•m²)
Sheet and panel-type materials		
12.7 mm gypsum board	0.02	2600
• painted (1 coat primer)	negligible	1300
• painted (1 coat primer + 2 coats latex paint)	negligible	180
12.7 mm foil-backed gypsum board	negligible	negligible
12.7 mm gypsum board sheathing	0.0091	1373
6.4 mm plywood	0.0084	23 -74
11 mm oriented strandboard	0.0108	44 (range)
12.5 mm cement board	0.147	590
plywood (from 9.5 mm to 18 mm)	negligible - 0.01	40 - 57
fibreboard sheathing	0.012 - 1.91	100 - 2900
17 mm wood sheathing	high - depends on no. of joints	982
Insulation		
27 mm foil-faced polyisocyanurate	negligible	4.3
27 mm paper-faced polyisocyanurate	negligible	61.1
25 mm extruded polystyrene	negligible	23 - 92
25 mm expanded polystyrene (Type 2)	0.0214	86 - 160
fibrous insulations	very high	very high
25 mm polyurethane spray foam - low density	0.011	894 - 3791
25 mm polyurethane spray foam - medium density	negligible	96(2)
Membrane-type materials		
asphalt-impregnated paper (10 min paper)	0.0673	370
asphalt-impregnated paper (30 min paper)	0.40	650
asphalt-impregnated paper (60 min paper)	0.44	1800
water-resistive barriers (9 materials)	negligible - 4.3	30 - 1200
0.15 mm polyethylene	negligible	1.6 - 5.8
asphalt-saturated felt (#15)	0.153	290
building paper	0.2706	170 - 1400
spun-bonded polyolefin film (expanded)	0.9593	3646
Other materials		
brick (6 materials)	negligible	102 - 602
metal	negligible	negligible
mortar mixes (4 materials)	negligible	13 - 690
stucco	negligible	75 - 240
50 mm reinforced concrete (density: 2 330 kg/m³)	negligible	23

Notes to Table A-9.25.5.1.(1)

(1) Air leakage and vapour permeance values derived from:
- Bombaru, D., Jutras, R. and Patenaude, A. Air Permeance of Building Materials. Summary Report prepared by AIR-INS Inc. for Canada Mortgage and Housing Corporation, Ottawa, 1988. Values indicate properties of tested materials only; values for specific products may vary significantly.
- Details of Air Barrier Systems for Houses. Tarion Warranty Corporation (formerly Ontario New Home Warranty Program), Toronto, 1993.
- Kumaran, M.K., el al., ASHRAE Research Report 1018 RP, A Thermal and Moisture Transport Property Database for Common Building and Insulating Materials.
- Kumaran, M.K., Lackey, J., Normandin N., van Reenen, D., Tariku, F., Summary Report from Task 3 of MEWS Project at the Institute for Research in Construction-Hygrothermal Properties of Several Building Materials, IRC- RR-110, March 2002.
- Mukhopadhyaya, P., Kumarai M.K., et al., Hygrothermal Properties of Exterior Claddings, Sheathing Boards, Membranes and Insulation Materials for Building Envelope Design, Proceedings of Thermal Performance of the Exterior Envelopes of Whole Building X, Clearwater, Florida, December 2-7,2007, pp. 1-16 (NRCC-50287).

(2) This water vapour permeance value is for a 25 mm thick core layer of medium density polyurethane spray foam. When installed in the field, a low permeance resin layer forms where the foam is in contact with the substrate. The water vapour permeance of the installed foam, were it measured including the resin layer, would therefore likely be lower than the value listed in the Table.

A-9.25.5.2. Assumptions Followed in Developing Table 9.25.5.2.

Article 9.25.5.2. specifies that a low air- and vapour-permeance material must be located on the warm face of the assembly, outboard of a vented air space, or within the assembly at a position where its inner surface is likely to be warm enough for most of the heating season such that no significant accumulation of moisture will occur. This last position is defined by the ratio of the thermal resistance values outboard and inboard of the innermost impermeable surface of the material in question.

The design values given in Table 9.25.5.2. are based on the assumption that the building includes a mechanical ventilation system (between 0.3 and 0.5 air changes per hour), a 60 ng/(Pa•s•m^2) vapour barrier, and an air barrier (values between 0.024 and 0.1 L/(s•m^2) through the assembly were used). The moisture generated by occupants and their use of bathrooms, cleaning, laundry and kitchen appliances was assumed to fall between 7.5 and 11.5 L per day.

It has been demonstrated through modelling under these conditions that assemblies constructed according to the requirements in Table 9.25.5.2. do not lead to moisture accumulation levels that may lead to deterioration as long as the average monthly vapour pressure difference between the exterior and interior sides over the heating season does not increase above 750 Pa, which would translate into an interior relative humidity (RH) of 35% in colder climates and 60% in mild climates.

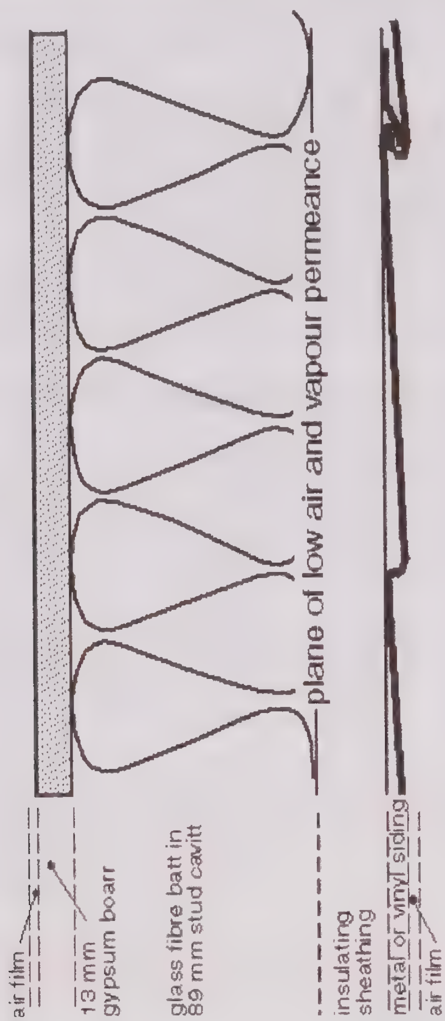
Health Canada recommends indoor relative humidities between 35% and 50% for healthy conditions. ASHRAE accepts a 30% to 60% range. Environments that are much drier tend to exacerbate respiratory problems and allergies; more humid environments tend to support the spread of microbes, moulds and dust mites, which can adversely affect health.

In most of Canada in the winter, indoor RH is limited by the exterior temperature and the corresponding temperature on the inside of windows. During colder periods, indoor RH higher than 35% will cause significant condensation on windows. When this occurs, occupants are likely to increase the ventilation to remove excess moisture. Although indoor RH may exceed 35% for short periods when the outside temperature is warmer, the criteria provided in Table 9.25.5.2. will still apply. Where higher relative humidities are maintained for extended periods in these colder climates, the ratios listed in the Table may not provide adequate protection.

Table 9.25.5.2. cannot be used for occupancies that require that RH be maintained above 35% throughout the year and for those interior spaces that support activities, such as swimming, that create high relative humidities. In these cases the position of the materials must be determined according to Part 5.

It should be noted that Part 9 building envelopes in regions with colder winters have historically performed acceptably when the indoor RH does not exceed 35% over most of the heating season. With tighter building envelopes, it is possible to raise indoor RH levels above 35%. There is no information, however, on how Part 9 building envelopes will perform when exposed to these higher indoor RH levels for extended periods during the heating season over many years. Operation of the ventilation system, as intended to remove indoor pollutants, will maintain the lower RH levels as necessary.

The method of calculating the inboard to outboard thermal resistance ratio is illustrated in Figure A-9.25.5.2. The example wall section shows three planes where low air- and vapour-permeance materials have been installed. A vapour barrier, installed to meet the requirements of Subsection 9.25.4., is on the warm side of the insulation consistent with Clause 9.25.1.2.(1)(a) and Sentences 9.25.4.1.(1) and 9.25.4.3.(2). The vinyl siding has an integral drained and vented air space consistent with Clause 9.25.1.2.(1)(c). The position of the interior face of the low-permeance insulating sheathing, however, must be reviewed in terms of its thermal resistance relative to the overall thermal resistance of the wall, and the climate where the building is located.



	Inboard			Outboard		
RSI value	0.12	0.08	2.11	0.87	0.12	0.03
Total RSI value	2.31			1.02		
Ratio	1.02 / 2.31 = 0.44					

Figure A-9.25.5.2.
Example Wall Section Showing Thermal Resistance Inboard and Outboard of a Plane of Low Air and Vapour Permeance

Comparing the RS1 ratio from the example wall section with those in Table 9.25.5.2. indicates that this wall would be acceptable in areas with Celsius degree-day values up to 7999, which includes, for example, Geraldton. (Degree-day values for various locations in Ontario are provided in MMAH Supplementary Standard SB-1.

A similar calculation would indicate that, for a similar assembly but with a 140 mm stud cavity filled with an RSI 3.52 batt, the ratio would be 0.28. Thus such a wall could be used in areas with Celsius degree-day values up to 4999, which includes, for example, Ottawa.

Similarly, if half the thickness of the same low permeance sheathing were used, the ratio with an 89 mm cavity would be 0.25, permitting its use in areas with Celsius degree-day values up to 4999. The ratio with a 140 mm cavity would be 0.16; thus this assembly could not be used anywhere, since this ratio is below the minimum permitted in Table A-9.25.5.2.

Table A-9.25.5.2. shows the minimum thicknesses of low permeance insulating sheathing necessary to satisfy Article 9.25.5.2. in various degree-day zones for a range of resistivity values of insulating sheathing. These thicknesses are based on the detail shown in Figure A-9.25.5.2. but could also be used with cladding details, such as brick veneer or wood siding, which provide equal or greater outboard thermal resistance.

Table A-9.25.5.2.
Minimum Thicknesses of Low Permeance Insulating Sheathing

Celsius Heating Degree-days	Min. RSI Ratio	38 x 89 mm Framing					38 x 140 mm Framing				
		Min. Outboard Thermal Resistance, RSI	Min. Sheathing Thickness, mm				Min. Outboard Thermal Resistance, RSI	Min. Sheathing Thickness, mm			
			Sheathing Thermal Resistance, RSI/mm					Sheathing Thermal Resistance, RSI/mm			
			0.0300	0.0325	0.0350	0.0400		0.0300	0.0325	0.0350	0.0400
≤ 4999	0.20	0.46	10	10	9	8	0.72	19	17	16	14
5000 to 5999	0.30	0.69	18	17	16	14	1.07	31	28	26	23
6000 to 6999	0.35	0.81	22	20	19	16	1.25	37	34	32	28
7000 to 7999	0.40	0.92	26	24	22	19	1.43	43	39	37	32
Column 1	2	3	4	5	6	7	8	9	10	11	12

References

(1) Exposure Guidelines for Residential Indoor Air Quality, Environmental Health Directorate, Health Protection Branch, Health Canada, Ottawa, April 1987 (Revised July 1989).
(2) ANSI/ASHRAE 62, "Ventilation for Acceptable Indoor Air Quality."

A-9.26.1.1.(2) Platforms that Effectively Serve as Roofs.

Decks, balconies, exterior walkways and similar exterior surfaces effectively serve as roofs where these platforms do not permit the free drainage of water through the deck. Unless the surface slopes to the outside edges and water can freely drain over the edge, water will pond on the surface. When rain is driven across the deck (roof) surface, water will move upward when it encounters an interruption.

A-9.26.2.2.(4) Fasteners for Treated Shingles.

Where shingles or shakes have been chemically treated with a preservative or a fire retardant, the fastener should be of a material known to be compatible with the chemicals used in the treatment.

A-9.26.4.1. Junctions Between Roofs and Walls or Guards.

Drainage of water from decks and other platforms that effectively serve as roofs will be blocked by walls, and blocked or restricted by guards where significant lengths and heights of material are connected to the deck. Without proper flashing at such roof-wall junctions or roof-guard junctions, water will generally leak into the adjoining elements and can penetrate into supporting assemblies below. Exceptions include platforms where waterproof curbs of sufficient height are cast-in or where the deck and wall or guard are unit-formed. In these cases, the monolithic deck-wall or deck-guard junctions will minimize the likelihood of water ingress. (See also Appendix Note A-9.26.1.1.(2).)

A-9.26.6.1.(1) Underlay Beneath Shingles.

While underlayment has not traditionally been required by the Code, some shingle manufacturers require its use beneath their products.

A-9.26.17.1.(1) Installation of Concrete Roof Tiles.

Where concrete roof tiles are to be installed, the dead load imposed by this material should be considered in determining the minimum sizes and maximum spans of the supporting roof members.

A-9.27.2. Required Protection from Precipitation.

Part 5 and Part 9 of the Building Code recognize that mass walls and face-sealed, concealed barrier and rainscreen assemblies have their place in the Canadian context.

Mass walls are generally constructed of cast-in-place concrete or masonry. Without cladding or surface finish, they can be exposed to precipitation for a significant period before moisture will penetrate from the exterior to the interior. The critical characteristics of these walls are related to thickness, mass, and moisture transfer properties, such as shedding, absorption and moisture diffusion.

Face-sealed assemblies have only a single plane of protection. Sealant installed between cladding elements and other envelope components is part of the air barrier system and is exposed to the weather. Face-sealed assemblies are appropriate where it can be demonstrated that they will provide acceptable performance with respect to the health and safety of the occupants, the operation of building services and the provision of conditions suitable for the intended occupancy. These assemblies, however, require more intensive, regular and on-going maintenance, and should only be selected on the basis of life-cycle costing considering the risk of failure and all implications should failure occur. Climate loads such as wind-driven rain, for example, should be considered. Face-sealed assemblies are not recommended where the building owner may not be aware of the maintenance issue or where regular maintenance may be problematic.

Concealed barrier assemblies include both a first and second plane of protection. The first plane comprises the cladding, which is intended to handle the majority of the precipitation load. The second plane of protection is intended to handle any water that penetrates the cladding plane. It allows for the dissipation of this water, primarily by gravity drainage, and provides a barrier to further ingress.

Like concealed barrier assemblies, rainscreen assemblies include both a first and second plane of protection. The first plane comprises the cladding, which is designed and constructed to handle virtually all of the precipitation load. The second plane of protection is designed and constructed to handle only very small quantities of incidental water; composition of the second plane is described in Appendix Note A-9.27.3.1. In these assemblies, the air barrier system, which plays a role in controlling precipitation ingress due to air pressure difference, is protected from the elements. (See Figure A-9.27.2.)

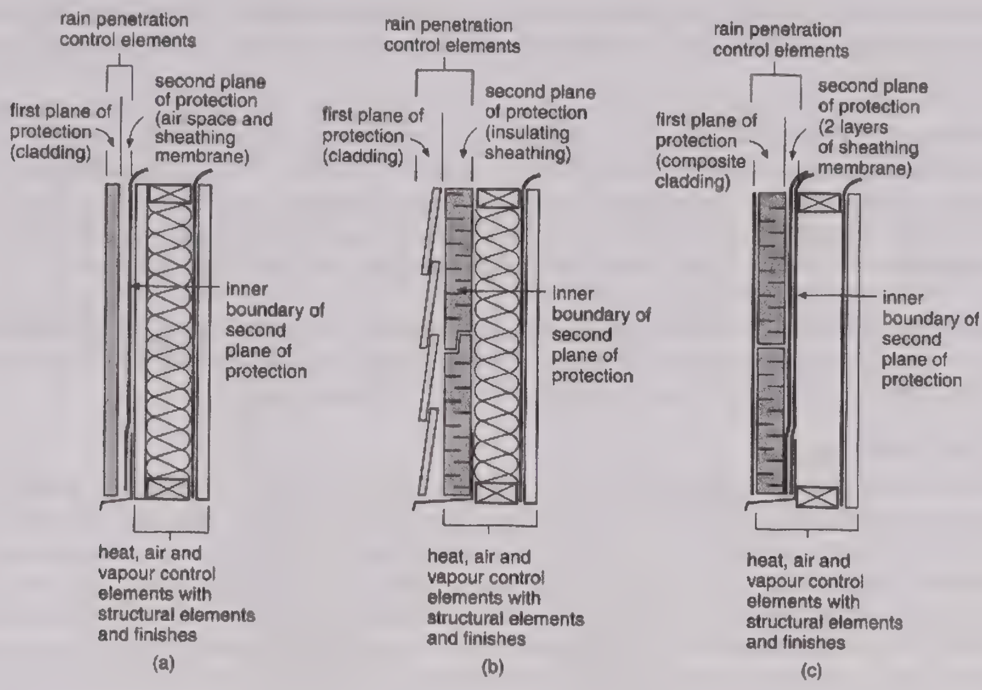


Figure A-9.27.2.
Generic Rainscreen Assemblies

A-9.27.2.1.(1) Minimizing Precipitation Ingress.

The total prevention of precipitation ingress into wall assemblies is difficult to achieve and, depending on the wall design and construction, may not be absolutely necessary. The amount of moisture that enters a wall, and the frequency with which this occurs, must be limited. The occurrence of ingress must be sufficiently rare, accumulation sufficiently small and drying sufficiently rapid to prevent the deterioration of moisture-susceptible materials and the growth of fungi.

A-9.27.2.2.(1) Required Levels of Protection from Precipitation.

Part 9 provides guidance to assist in determining the minimum levels of protection from precipitation to be provided by cladding assemblies. Article 9.27.2.2. describes the minimum cladding assembly configuration. Designers must still consider local accepted good practice, demonstrated performance and the specific conditions to which a particular wall will be exposed when designing or selecting a cladding assembly.

A.9.27.3.1. Second Plane of Protection.

As specified in Sentence 9.27.3.1.(1), the second plane of protection consists of a drainage plane with an appropriate material serving as the inner boundary and flashing to dissipate rainwater or meltwater to the exterior.

Drainage Plane

Except for masonry walls, the simplest configuration of a drainage plane is merely a vertical interface between materials that will allow gravity to draw the moisture down to the flashing to allow it to dissipate to the exterior. It does not necessarily need to be constructed as a clear drainage space (air space).

For masonry walls, an open rainscreen assembly is required; that is, an assembly with first and second planes of protection where the drainage plane is constructed as a drained and vented air space. Such construction also constitutes best practice for walls other than masonry walls.

Section 9.20. requires drainage spaces of 25 mm for masonry veneer walls and 50 mm for cavity walls. In other than masonry walls, the drainage space in an open rainscreen assembly should be at least 10 mm deep. Drainage holes must be designed in conjunction with the flashing.

Sheathing Membrane

The sheathing membrane described in Article 9.27.3.2. is not a waterproof material. When installed to serve as the inner boundary of the second plane of protection, and when that plane of protection includes a drainage space at least 10 mm deep, the performance of the identified sheathing membrane has been demonstrated to be adequate. This is because the material is expected to have to handle only a very small quantity of water that penetrates the first plane of protection.

If the 10 mm drainage space is reduced or interrupted, the drainage capacity and the capillary break provided by the space will be reduced. In these cases, the material selected to serve as the inner boundary may need to be upgraded to provide greater water resistance in order to protect moisture-susceptible materials in the backing wall.

Appropriate Level of Protection

It is recognized that many cladding assemblies with no space or with discontinuous space behind the cladding, and with the sheathing membrane material identified in Article 9.27.3.2., have provided acceptable performance with a range of precipitation loads imposed on them. Vinyl and metal strip siding, and shake and shingle cladding, for example, are installed with discontinuous drained spaces, and have demonstrated acceptable performance in most conditions. Lapped wood and composite strip sidings, depending on their profiles, may or may not provide discontinuous spaces, and generally provide little drainage. Cladding assemblies with limited drainage capability that use a sheathing membrane meeting the minimum requirements are not recommended where they may be exposed to high precipitation loads or where the level of protection provided by the cladding is unknown or questionable. Local practice with demonstrated performance should be considered. (See also Article 9.27.2.2. and Appendix Note A-9.27.2.2.(1)).

A-9.27.3.4.(2) Detailing of Joints in Exterior Insulating Sheathing.

The shape of a joint is critical to its ability to shed water. Tongue and groove, and lapped joints can shed water if oriented correctly. Butt joints can drain to either side and so should not be used unless they are sealed. However, detailing of joints requires attention not just to the shape of the joint but also to the materials that form the joint. For example, even if properly shaped, the joints in insulating sheathing with an integral sheathing membrane could not be expected to shed water if the insulating material absorbs water, unless the membrane extends through the joints.

A-9.27.3.5.(1) Sheathing Membranes in Lieu of Sheathing.

Article 9.23.16.1., Required Sheathing, indicates that sheathing must be installed only where the cladding requires intermediate fastening between supports (studs) or where the cladding requires a solid backing. Cladding such as brick or panels would be exempt from this requirement and in these cases a double layer of sheathing membrane would generally be needed. The exception (Article 9.27.3.6.) applies only to those types of cladding that provide a face seal to the weather.

A-9.27.3.6. Sheathing Membrane Under Face Sealed Cladding.

The purpose of sheathing membrane on walls is to reduce air infiltration and to control the entry of wind-driven rain. Certain types of cladding consisting of very large sheets or panels with well-sealed joints will perform this function, eliminating the need for sheathing membrane. This is true of the metal cladding with lock-seamed joints sometimes used on mobile homes. However, it does not apply to metal or plastic siding applied in narrow strips which is intended to simulate the appearance of lapped wood siding. Such material does not act as a substitute for sheathing membrane since it incorporates provision for venting the wall cavity and has many loosely-fitted joints which cannot be counted on to prevent the entry of wind and rain.

Furthermore, certain types of sheathing systems can perform the function of the sheathing membrane. Where it can be demonstrated that a sheathing material is at least as impervious to air and water penetration as sheathing membrane and that its jointing system results in joints that are at least as impervious to air and water penetration as the material itself, sheathing membrane may be omitted.

A-9.27.3.8.(1) Required Flashing.

Horizontal Offsets

Where a horizontal offset in the cladding is provided by a single cladding element, there is no joint between the offset and the cladding above. In this case, and provided the cladding material on the offset provides effective protection for the construction below, flashing is not required.

Changes in Substrate

In certain situations, flashing should be installed at a change of substrate: for example, where stucco cladding is installed on a wood-frame assembly, extending down over a masonry or cast-in-place concrete foundation and applied directly to it. Such an application does not take into account the potential for shrinkage of the wood frame and cuts off the drainage route for moisture that may accumulate behind the stucco on the frame construction.

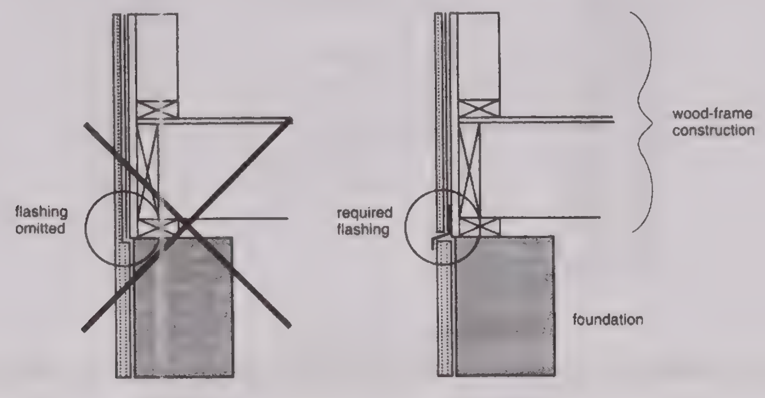


Figure A-9.27.3.8.(1)
Flashing at Change in Substrate

A.9.27.3.8.(3) Flashing Over Curved-Head Openings.

The requirement for flashing over openings depends on the vertical distance from the top of the trim over the opening to the bottom of the eave compared to the horizontal projection of the eave. In the case of curved-head openings, the vertical distance from the top of the trim increases as one moves away from the centre of the opening. For these openings, the top of the trim must be taken as the lowest height before the trim becomes vertical. (See Figure A-9.27.3.8.(3).)

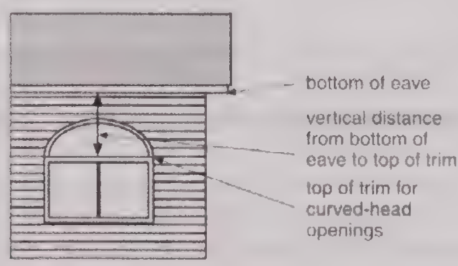


Figure A-9.27.3.8.(3)
Flashing Over Curved-Head Openings

A-9.27.3.8.(4) Flashing Configuration and Positive Drainage.

Flashing Configuration

A 6% slope is recognized as the minimum that will provide effective flashing drainage. The 10 mm vertical lap over the building element below and the 5 mm offset are prescribed to reduce transfer by capillarity and surface tension. Figure A-9.27.3.8.(4) illustrates two examples of flashing configurations.

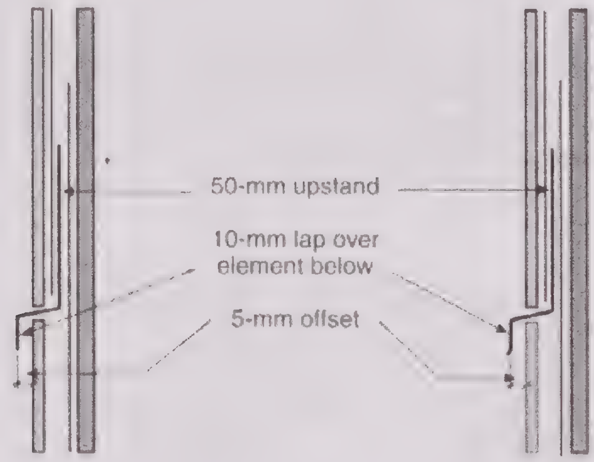


Figure A-9.27.3.8.(4)
Examples of Flashing Configurations Showing Upstands, Horizontal Offsets and Vertical Laps

Maintaining Positive Slope

Sentence 9.27.3.8.(4) requires that the minimum 6% flashing slope remain after expected shrinkage of the building frame. Similarly, Sentence 9.26.3.1.(4) requires that a positive slope remain on roofs and similar assemblies after expected shrinkage of the building frame.

For Part 9 wood-frame construction, expected wood shrinkage can be determined based on the average equilibrium moisture content (MC) of wood, within the building envelope assembly. According the Canadian Wood Council's Wood Reference Handbook, the equilibrium moisture content (equilibrium MC) for wood in Ontario is 8%.

For three-storey construction to which Part 9 applies, the cumulative longitudinal shrinkage is negligible. Shrinkage need only be calculated for horizontal framing members using the following formula (from Introduction to Wood Building Technology, Canadian Wood Council, Ottawa, 1997):

Shrinkage = (total horizontal member height) x (initial MC - equilibrium MC) x (0.002)

A-9.27.3.8.(5) Protection Against Precipitation Ingress at the Sill-to-Cladding Joint.

Many windows are configured in such a way that a line of sealant is the only protection against water ingress at the sill-to-cladding joint & a location that is exposed to all of the water that flows down the window. In the past, many windows were constructed with self-flashing sills & sills that extend beyond the face of the cladding and have a drip on the underside to divert water away from the sill-to-cladding joint. This sill configuration was considered to be accepted good practice and is recognized today as providing a degree of redundancy in precipitation protection.

Self-flashing sills are sills that

- slope toward the exterior where the sills have an upward facing surface that extends beyond the jambs,
- where installed over a masonry sill, extend not less than 25 mm beyond the inner face of that sill,
- incorporate a drip positioned not less than 5 mm outward from the outer face of the cladding below or not less than 15 mm beyond the inner edge of a masonry sill, and
- terminate at the jambs or, where the face of the jambs is not at least flush with the face of the cladding and the sills extend beyond the jambs, incorporate end dams sufficiently high to protect against overflow in wind-driven rain conditions.

A wind pressure of 10 Pa can raise water 1 mm. Thus, for example, if a window is exposed to a driving rain wind pressure of 200 Pa, end dams should be at least 20 mm high.

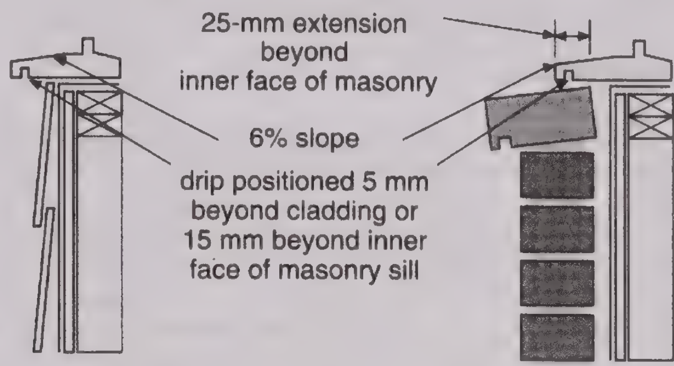


Figure A-9.27.3.8.(5)
Examples of Configurations of Self-Flashing Sills

A-9.27.4.2.(1) Selection and Installation of Sealants.

Analysis of many sealant joint failures indicates that the majority of failures can be attributed to improper joint preparation and deficient installation of the sealant and various joint components. The following ASTM guidelines describe several aspects that should be considered when applying sealants in unprotected environments to achieve a durable application:

- ASTM C1193, "Use of Joint Sealants,"
- ASTM C1299, "Selection of Liquid-Applied Sealants,"
- ASTM C1472, "Calculating Movement and Other Effects When Establishing Sealant Joint Width."

The sealant manufacturer's literature should always be consulted for recommended procedures and materials.

A-9.27.9.2.(3) Grooves in Hardboard Cladding.

Grooves deeper than that specified may be used in thicker cladding providing they do not reduce the thickness to less than the required thickness minus 1.5 mm. Thus for Type 1 or 2 cladding, grooves must not reduce the thickness to less than 4.5 mm or 6 mm depending on method of support, or to less than 7.5 mm for Type 5 material.

A-9.27.10.2.(2) Thickness of Grade O-2 OSB.

In using Table 9.27.8.2. to determine the thickness of Grade O-2 OSB cladding, substitute "face orientation" for "face grain" in the column headings.

A-9.27.11.1.(3) and (4) Material Standards for Aluminum Cladding.

Compliance with Sentence 9.27.11.1.(3) and CAN/CGSB-93.2-M, "Prefinished Aluminum Siding, Soffits, and Fascia for Residential Use", is required for aluminum siding that is installed in horizontal or vertical strips. Compliance with Sentence 9.27.11.1.(4) and CAN/CGSB-93.1-M, "Sheet, Aluminum Alloy, Prefinished, Residential", is required for aluminum cladding that is installed in large sheets.

A-Table 9.28.4.3. Stucco Lath.

Paper-backed welded wire lath may also be used on horizontal surfaces provided its characteristics are suitable for such application.

A-9.30.1.2.(1) Water Resistance.

In some areas of buildings, water and other substances may frequently be splashed or spilled onto the floor. It is preferable, in such areas, that the finish flooring be a type that will not absorb moisture or permit it to pass through; otherwise, both the flooring itself and the subfloor beneath it may deteriorate. Also, particularly in food preparation areas and bathrooms, unsanitary conditions may be created by the absorbed moisture. Where absorbent or permeable flooring materials are used in these areas, they should be installed in such a way that they can be conveniently removed periodically for cleaning or replacement, i.e., they should not be glued or nailed down. Also, if the subfloor is a type that is susceptible to moisture damage (this includes virtually all of the wood-based subfloor materials used in wood frame construction), it should be protected by an impermeable membrane placed between the finish flooring and the subfloor. The minimum degree of impermeability required by Sentence 9.30.1.2.(1) would be provided by such materials as polyethylene, aluminum foil, and most single-ply roofing membranes (EPDM, PVC).

A-9.31.6.2.(3) Securement of Service Water Heaters.

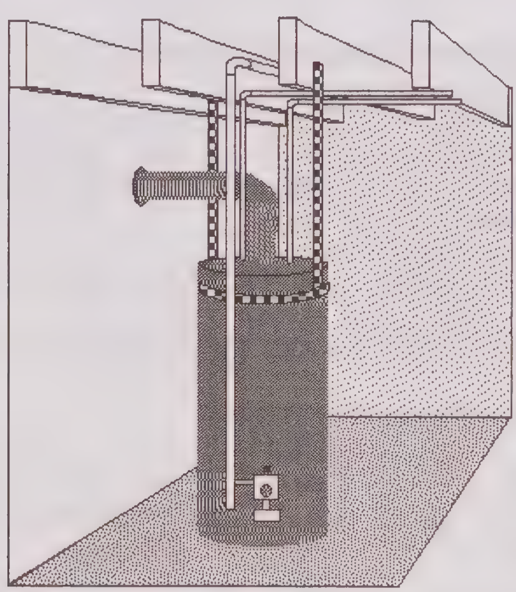


Figure A-9.31.6.2.(3)
Securement of Service Water Heater Using Strapping Fastened to Floor Joists Overhead

A-9.32.3. Mechanical Ventilation.

For many years, houses were constructed without mechanical ventilation systems and relied on natural air leakage through the building envelope for winter ventilation. However, houses have become progressively more airtight through the introduction of new products and practices, e.g., the substitution of panel sheathings such as plywood and waferboard for board sheathing, the

replacement of paper-backed insulation batts with friction-fit batts and polyethylene film, improved caulking materials, tighter windows and doors, and more efficient heating systems. Following the energy crisis in the early 1970's, considerable emphasis was placed on reducing air leakage in order to conserve energy. Electric heating systems were encouraged and higher efficiency furnaces were developed, which further reduced air change rates in buildings. This led to concern that the natural air change in dwelling units might be insufficient in some instances to provide adequate indoor air quality. Condensation problems resulting from higher humidity levels were also a concern.

Mechanical ventilation requirements in the Building Code have evolved from a simple requirement in the 1983 edition that exhaust fans be incorporated in electrically heated houses, through requirements in the 1986 and 1990 editions that all houses have mechanical ventilation systems capable of exchanging the indoor air for outdoor air at a specified rate: 0.5 air changes per hour in the 1986 edition and 0.3 air changes per hour in the 1990 edition. The current requirements address not only the overall air change rate created by the mechanical ventilation system but also the need to ensure that the outdoor air brought into the house by the system is distributed throughout the house.

A-9.33.1.1. Combustion Air and Tight Houses.

The operation of an air exhaust system or of a fuel-burning appliance removes the air from a house, creating a slight negative pressure inside. In certain cases the natural flow of air up a chimney can be reversed, leading to a possible danger of carbon monoxide poisoning for the inhabitants.

Newer houses are generally more tightly constructed than older ones because of improved construction practices, including tighter windows, weather stripping and caulking. This fact increases the probability that infiltration may not be able to supply enough air to compensate for simultaneous operation of exhaust fans, fireplaces, clothes dryers, furnaces and space heaters. It is necessary, therefore, to introduce outside air to the space containing the fuel-burning appliance. Information regarding combustion air requirements for various types of appliances can be found in the installation standards referenced in Articles 6.2.1.4. and 9.33.1.2. In the case of solid-fuel burning stoves, ranges and space heaters, CAN/CSA-B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment" suggests that the minimum size of openings be determined by trial and error to accommodate the flue characteristics, the firing rate, the building characteristics, etc., and that, as a guide, the combustion air opening should be 0.5 times the flue collar area.

Further information is available in Canadian Building Digest 222, "Airtight Houses and Carbon Monoxide Poisoning", from the Institute for Research in Construction, National Research Council of Canada, Ottawa K1A 0R6.

A-9.33.1.2.(1) Design, Construction and Installation Standard for Solid-Fuel-Burning Appliances.

CAN/CSA-B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment" is essentially an installation standard, and covers such issues as accessibility, air for combustion and ventilation, chimney and venting, mounting and floor protection, wall and ceiling clearances, installation of ducts, pipes, thimbles and manifolds, and control and safety devices. But the standard also includes a requirement that solid-fuel-burning appliances and equipment satisfy the requirements of one of a series of standards, depending on the appliance or equipment, therefore also making it a design and construction standard. It is required that stoves, ranges, central furnaces and other space heaters be designed and built in conformity with the relevant referenced standard.

A-9.33.4. Carbon Monoxide Alarms.

Carbon monoxide (CO) is a colourless, odourless gas that can build up to lethal concentrations in an enclosed space without the occupants being aware of it. Thus, where an enclosed space incorporates or is near a potential source of CO, it is prudent to provide some means of detecting its presence.

Dwelling units have two common potential sources of CO:

- fuel-fired space- or water-heating equipment within the dwelling unit or in adjacent spaces within the building, and
- attached storage garages.

Most fuel-fired heating appliances do not normally produce CO and, even if they do, it is normally conveyed outside the building bv the appliance's venting system. Nevertheless, appliances can malfunction and venting systems can fail. Therefore, the provision

of appropriately placed CO alarms in the dwelling unit is a relatively low-cost back-up safety measure. Similarly, although Article 9.10.9.16. requires that the walls and floor/ceiling assemblies separating attached garages from dwelling units incorporate an air barrier system, there have been several instances of CO from garages being drawn into houses, which indicates that a fully gas-tight barrier is difficult to achieve. The likelihood of preventing the entry of all CO is decreased if the dwelling unit is depressurized in relation to the garage. This can readily occur due to the operation of exhaust equipment or simply due to the stack effect created by heating the dwelling unit. Again, CO alarms in the dwelling unit provide a relatively low-cost back-up safety measure.

A-9.39. Cold Room Slabs.

Design Assumptions

1. Density of Reinforced Concrete = 23.5 kN/m^3.

2. Live Loads - As per Sentence 9.4.2.3 (1) of the Building Code, the live load is the lesser of the following:
   - 1.9 kPa,
   - Specified roof snow load, which for Ontario is up to 2.9 kPa.

Therefore a specified design load of 3.0 kPa is appropriate; however, the slab specified is capable of carrying higher live loads since the crack control requirements of CSA A23.3 and cover requirements as given below govern the design of the slab.

3. Design Standards: CSA A23.3-94, "Design of Concrete Structures".

4. Exposure and Cover for Reinforcing Steel:
   - The slab is considered to be exposed to weather and de-icing chemicals.
   - Minimum top cover is 60 mm as per CSA A23.3 Clause A15.1.7.1 plus a 12 mm tolerance on placement.
   - Minimum bottom cover is 30 mm as per CSA A23.3 Clause A12.6.2 (slab cast against formwork).
   - For 10M reinforcing bars the minimum slab thickness is 72 mm cover + 11.3 mm bar + 11.3 mm bar + 30 mm cover = 125 mm.

5. Design Assumptions:
   - Concrete compressive strength of 32 MPa at 28 days as per Sentence 9.3.1.6.(1) of the Building Code.
   - Reinforcing steel yield strength of 400 MPa.
   - Slab design is based on a one-way slab simply supported on foundation walls along the edges. Since the slab can be square or rectangular, the same steel is provided in both directions.
   - Maximum span is limited to 20 times the slab thickness as per CSA A23.3 Table 9.1.

Appendix B

Imperial Conversions of Metric Values

Imperial conversions may be determined using the factors listed below.

Conversion Factors		
to Convert	to	Multiply by
°C	°F	1.8 and add 32
g	oz	0.0353
g	lb	0.0022
kg	lb	2.2046
kg/m^2	lb/ft^2	0.20481
kPa	lb/in^2	0.14503
kPa	lb/ft^2	20.885
L	gal (Imp)	0.21997
L	gal (US)	0.26417
L/m^2	gal/ft^2 (Imp)	0.02044
L/s*	gal/min (Imp)	13.198
L/s*	gal/min (US)	15.850
L/s**	ft^3/min	2.1189
L/s•m	cfm/ft	0.64584
$L/s•m^2$	cfm/ft^2	0.19685
lx	ft-candle	0.09290
mm	in	0.03937
m	ft	3.2808
m^2	ft^2	10.764
m^3	ft^3	35.315
m^3/h	ft^3/min	0.58857
m/s	ft/min	196.85
MJ	Btu	947.82
m^2•°C/W (RSI)	ft^2•h•°F/Btu (R)	5.6785
N	lbf	0.22481
$ng/Pa•s•m^2$	perms	0.01741
W	Btu/h	3.4122
Column 1	2	3

Notes:
* liquid volume flowrate
** air volume flowrate

SI Units and Their Multiples

The SI prefixes used to form names and symbols of decimal multiples and sub-multiples of SI units are:

Prefix	Symbol	Magnitude	Factor
exa	E	1 000 000 000 000 000 000	10^{18}
peta	P	1 000 000 000 000 000	10^{15}
tera	T	1 000 000 000 000	10^{12}
giga[1]	G	1 000 000 000	10^{9}
mega[1]	M	1 000 000	10^{6}
kilo[1]	k	1 000	10^{3}
hecto[2]	h	100	10^{2}
deca[2]	da	10	10^{1}
deci[2]	d	0.1	10^{-1}
centi[2]	c	0.01	10^{-2}
milli[1]	m	0.001	10^{-3}
micro[1]	µ	0.000 001	10^{-6}
nano[1]	n	0.000 000 001	10^{-9}
pico	p	0.000 000 000 001	10^{-12}
femto	f	0.000 000 000 000 001	10^{-15}
atto	a	0.000 000 000 000 000 001	10^{-18}
Column 1	2	3	4

Notes:

(1) most frequently used

(2) avoid if possible

Building Code Cross References

DIVISION A * Illustrated

Part I

DIVISION B * Illustrated

Part I

Part 3

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Part 7

Part 9

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Part 12

DIVISION C * Illustrated

Part 1

Part 2

SUPPLEMENTARY STANDARD SB-12

*** Illustrated**

PLANS EXAMINATION CHECKLIST

PART 9 HOUSING

2012 Building Code (O. Reg. 332/12)
to Amending O. Regs. 368/13

The Purpose of this checklist is to provide assistance to Building Officials, Designers, and Builders in plans review and inspection.

This checklist is for information purposes only and does not address all the requirements in the Building Code and other applicable law.

NIC = Not In Compliance

Room and Space Dimensions

NIC	O.K.		
☐	☐	Ceiling Heights	9.5.3.1.(1) and (2); Table 9.5.3.1.
☐	☐	Room Areas	9.5.4. to 9.5.8.
☐	☐	Hallway Width	9.5.10.1.(1)

Doors, Windows and Skylights

REQUIRED DOORS & SIZES

NIC	O.K.		
☐	☐	Required Doors	9.7.2.1.(1)
☐	☐	Doorway Sizes	9.5.11.1.(1); Table 9.5.11.1.

EXTERIOR DOORS & ENTRY

NIC	O.K.		
☐	☐	Door Sill Height, Opening Restriction & Required Guards	9.8.8.1.
☐	☐	Protection of Doors with Guards & Opening Restrictions	9.8.8.1.(4)
☐	☐	Exterior Doors	9.7.3.; 9.7.4.; 9.7.5.
☐	☐	Glass / Thermal Breaks	9.6.1.; 9.7.3.3.(1).
☐	☐	Resistance to Forced Entry	9.7.5.2.
☐	☐	Minimum Thermal Resistance of Doors	9.7.3.3.(3)

WINDOWS, GLAZING & SKYLIGHTS

NIC	O.K.		
☐	☐	Minimum Window Glass Area	9.7.2.3.; Table 9.7.2.3.
☐	☐	Openable Window > 0.35 m² on Floor Level Containing Bedrooms	9.9.10.1.(1)
☐	☐	Window Sills Above Floor or Ground	9.8.8.1.
☐	☐	Window Air Infiltration & Rating	9.7.4.1.
☐	☐	Window Standard AAMA/ WDMA/ CSA 101/I.S.2/A440 "NAFS - North American Fenestration Standard / Specification for Windows, Doors and Skylights"	9.7.4.; 9.7.6.
☐	☐	Resistance to Forced Entry	9.7.5.3.
☐	☐	Skylights, Plastic / Glass	9.7.4.; 9.7.6
☐	☐	Glazing Thermal Resistance	9.7.3.3.; SB-12*
☐	☐	Energy Rating for Electrically Heated Houses	12.3.1.2.
☐	☐	Natural Ventilation for Interior Rooms	9.32.2.1.; Table 9.32.2.1.

Stairs, Guards & Handrails

STAIR DIMENSIONS & HEADROOM

NIC	O.K.		
☐	☐	Step Dimensions, Rise, Run, Tread Width	9.8.4.; Table 9.8.4.1.
☐	☐	Interior Stairway Width	9.8.2.1.(1)
☐	☐	Headroom Clearance (1950 mm min.)	9.8.2.2.(1)(b)(i)

LANDINGS

NIC	O.K.		
☐	☐	Landing Dimensions (Interior & Exterior Stairs)	9.8.6.3., Table 9.8.6.3.
☐	☐	Required Landings	9.8.6.2.
☐	☐	Vert. Height Between Landings (3.7 m max.)	9.8.3.3.
☐	☐	Headroom Clearance (1950 mm min.)	9.8.6.4.(1)(a)
☐	☐	Location of Skylights	9.10.12.2.

* SB denotes Supplementary Standards to the 2012 Building Code Compendium (Volume 2).

NIC = Not In Compliance

RAMPS

NIC	O.K.		
☐	☐	Ramp Slope (1:10 max.)	9.8.5.4.(1)(a) and (b)
☐	☐	Level Ramp Area @ Door or Stairway	9.8.6.2.
☐	☐	Headroom Clearance	9.8.5.3.(1)(a)

HANDRAILS & GUARDS

NIC	O.K.		
☐	☐	Handrail on Int. Stairs > 2 Risers	9.8.7.1.(3)
☐	☐	Handrail on Ext. Stairs > 3 Risers	9.8.7.1.(3)
☐	☐	Continuous Handrail	9.8.7.2.(2)
☐	☐	Handrail Height - 800 - 965 mm / 1070 mm	9.8.7.4.(2) and (3)
☐	☐	Guards on Exterior Landings, Porches, Decks Where Difference in Elevation > 600 mm	9.8.8.1.(1)
☐	☐	Guards on Interior Stair > 2 Risers	9.8.8.1.(3)
☐	☐	Balcony Guard Height 1070 mm min.	9.8.8.3.(1); 9.8.8.3.(2)
☐	☐	Guard Height 900 mm min. Where Difference in Elevation of Landing, Porch < 1800 mm	9.8.8.3.(3)
☐	☐	Maximum Opening in Guards	9.8.8.5.(1)
☐	☐	Guard Designed to Prevent Climbing (Between 140 mm and 900 mm)	9.8.8.6.
☐	☐	Glass in Guards	9.8.8.7.(1)
☐	☐	Construction of Guards	9.8.8.2.; SB-7*

Means of Egress

EXITS & EGRESS FROM DWELLINGS

NIC	O.K.		
☐	☐	Types of Exits	9.9.2.1.
☐	☐	Use of Exits & Purpose of Exits	9.9.2.2.(1)
☐	☐	Stair Treads at Right Angle to Direction of Exit Travel	9.9.2.5.(1)

DOORS IN MEANS OF EGRESS

NIC	O.K.		
☐	☐	Ext. Doors Free of Ice & Snow Blockage With Max. 150 mm Riser	9.9.6.6.(2)

Fire Protection and Sound Control

SPATIAL SEPARATION BETWEEN BUILDINGS & EXTERIOR WALLS – OPTION 1

NIC	O.K.		
☐	☐	Percentage of Unprotected Openings Permitted in Exterior Walls	9.10.14.2.; 9.10.14.4. Table 9.10.14.4.
☐	☐	Openings in Walls with Limiting Distance < 1.2 m	9.10.14.4.(2)
☐	☐	FRR of Exterior Walls	9.10.14.5.; Table 9.10.14.5.
☐	☐	Cladding and Construction Type Required	9.10.14.5.; Table 9.10.14.5.

* SB denotes Supplementary Standards to the 2012 Building Code Compendium (Volume 2).

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SPATIAL SEPARATION BETWEEN HOUSES & EXTERIOR WALLS – OPTION 2

NIC	O.K.		
☐	☐	Percentage of Glazed Openings Permitted in Exterior Walls	9.10.15.2.; 9.10.15.4. Table 9.10.15.4.
☐	☐	Openings in Walls with Limiting Distance < 1.2 m	9.10.15.4.(4)
☐	☐	FRR of Exterior Walls	9.10.15.5.
☐	☐	Cladding and Construction Type Required	9.10.15.5.

FIRE-RESISTANCE RATING & FIRE SEPARATIONS

NIC	O.K.		
☐	☐	Support of Combustible Construction	9.10.9.8.(1)
☐	☐	Continuity of Fire Separation	9.10.9.2.(1); 9.10.9.6.
☐	☐	Party Walls Between Dwelling Units (1 h FRR)	9.10.11.2.; SB-3*
☐	☐	Firewall Construction, Height, FRR	9.10.11.3.

FIRE STOPPING, DAMPERS, DOORS & CLOSURES
(Row houses, semi-detached houses)

NIC	O.K.		
☐	☐	Closures & Protection of Openings in F/S	9.10.13.1.(1); Table 9.10.13.1.

SEPARATION OF SERVICE ROOMS & SPACES

NIC	O.K.		
☐	☐	Door Between Garage & Dwelling Unit	9.10.13.15.
☐	☐	Gas-Proofing	9.10.9.16.(4)
☐	☐	Smoke Alarms & Silencing	9.10.19.; 9.10.19.6.
☐	☐	Smoke Alarms with Visual Signal	9.10.19.3.(3) as of January 1 ,2015
☐	☐	Sound Control Between Dwelling Units	9.11.2.1.(1); SB-3*

FIREFIGHTING

NIC	O.K.		
☐	☐	Soffit Protection	9.10.12.4.
☐	☐	Access Route for Firefighting Equipment	9.10.20.3.

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Footings and Foundations

FOOTINGS & FOUNDATION WALLS

NIC	O.K.		
☐	☐	Concrete Compressive Strength	9.3.1.
☐	☐	Depth of Foundation, Frost Cover	9.12.2.1.; 9.12.2.2.; Table 9.12.2.2.
☐	☐	Strip, Column and Stepped Footing Design	9.15.3.; Table 9.15.3.4.
☐	☐	Lateral Support / Reinforcement	9.15.4.3.
☐	☐	Foundation Wall Thickness for Backfill Height & Lateral Support	9.15.4.2.; Tables 9.15.4.2.A. and 9.15.4.2.B.
☐	☐	Height Above Grade (150 mm min.)	9.15.4.6.(1)
☐	☐	Reduced Wall Thickness: Not < 90 & Not > 350 mm High	9.15.4.7.
☐	☐	Reinforcement of Flat Insulating Concrete Form Walls	9.15.4.5.; Table 9.15.4.5.
☐	☐	Fill Top Course of Concrete Blocks or Provide Wood Plate for Joist Support	9.15.5.1.
☐	☐	190 mm Deep Solid Bearing for Beam Support	9.15.5.2.
☐	☐	Parging & Coving of Masonry Walls	9.15.6.1.(1); 9.15.6.2.(1); 9.13.3.4.(1)
☐	☐	Slab-On-Ground	9.16.
☐	☐	Brick or Concrete Chimney Design	9.21.4.3.(1)
☐	☐	Anchor Bolts (12.7 mm diameter @ 2400 mm o.c.)	9.23.6.1.

WATERPROOFING & DAMPPROOFING

NIC	O.K.		
☐	☐	Hydrostatic Pressure Conditions	9.13.3.1.; 9.16.3.2.
☐	☐	Dampproofing of Walls	9.13.2.
☐	☐	Waterproofing of Walls	9.13.3.
☐	☐	Wood Frame Foundations (CAN/CSA-S406)	9.15.2.4.
☐	☐	Basement Floor Drain & Slope of Slab	9.31.4.4.; 9.16.3.3.(1)

DRAINAGE

NIC	O.K.		
☐	☐	Soil Gases	9.13.4.; SB-9*
☐	☐	Foundation Drainage / Installation	9.14.2.1.; 9.14.3.
☐	☐	Surface Drainage, Slope From Foundation	9.14.6.1.(1)
☐	☐	Catch Basin @ Sunken Garage	9.14.6.4.(1)

Crawl and Roof Spaces

CRAWL SPACES

NIC	O.K.		
☐	☐	Access Opening (min. 500 X 700 mm)	9.18.2.1.(1)
☐	☐	Natural Ventilation (0.1 m² per 50 m²) (See Exception)	9.18.3.1.(2); 9.18.3.2.(1)
☐	☐	Access Way Dimensions to Services	9.18.4.1.(1)
☐	☐	Drainage for Water Ingress	9.18.5.1.
☐	☐	Ground Cover	9.18.6.1.; 9.18.6.2.
☐	☐	FSR in Crawl Space Used as Plenum	9.18.7.1.

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ROOF SPACES

NIC	O.K.		
☐	☐	Vent Area (1:300 or 1:150)	9.19.1.1.; 9.19.1.2.(1) and (2)
☐	☐	Cross Purlin for Cathedral Ceiling	9.19.1.3.
☐	☐	Upper Portion of Mansard or Gambrel Vented	9.19.1.4.(2)
☐	☐	Attic Access (min. 500 x 700 mm)	9.19.2.1.(2)(b)

Framing and Structural Components

DESIGN LOADS & DEFLECTIONS

NIC	O.K.		
☐	☐	Design Loads	9.4.2.; 9.23.1.1.
☐	☐	Maximum Deflection	9.4.3.1.; Table 9.4.3.1.
☐	☐	Lumber Grades & Species	9.3.2.; Table 9.3.2.1.

LINTELS

NIC	O.K.		
☐	☐	Steel Lintels for Masonry	9.20.5.2.; Tables 9.20.5.2.A., B, and C
☐	☐	Wood Lintels	9.23.12.2.; 9.23.12.3.; Tables A-12 to A-19

BEAMS

NIC	O.K.		
☐	☐	Steel Beams	9.23.4.3.; Table 9.23.4.3.
☐	☐	Glulam Floor Beams	9.23.4.2.(3); Table A-11
☐	☐	Wood Beams	9.23.8.3.; Tables A-8 to A-12

COLUMNS

NIC	O.K.		
☐	☐	Steel Columns	9.17.3.
☐	☐	Wood Columns	9.17.4.
☐	☐	Masonry / Concrete Columns	9.17.5.; 9.17.6.
☐	☐	Reinforced Masonry and ICF for Earthquake Loads	9.20.15.

ROOF & CEILING FRAMING

NIC	O.K.		
☐	☐	Roof Rafters	9.23.4.2.(1); Tables A-6 and A-7
☐	☐	Collar Ties, Dwarf Walls & Struts	9.23.13.7.
☐	☐	Ceiling Joists	9.23.4.2.(1); Table A-3
☐	☐	Roof Joists	9.23.4.2.(1); Tables A-4 and A-5
☐	☐	Rafters & Joists continuous Doubled @ Openings	9.23.13.1.(1); 9.23.13.2.(1)
☐	☐	Restraint of Joist Bottoms	9.23.13.9.(1)
☐	☐	Ridge Support / Ridge Beams	9.23.13.8.; 9.23.4.2.(4); Table A-12
☐	☐	Roof Trusses	9.23.13.11.
☐	☐	Truss Drawings by Qualified Person	9.4.1.1.(1) and (2)

ROOF SHEATHING

NIC	O.K.		
☐	☐	Roof Sheathing / Materials & Installation	9.23.15.
☐	☐	Eave protection / Materials & Installation	9.26.5.1.; 9.26.5.2.(1)

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FLOOR JOISTS, FRAMING & BEAMS

NIC	O.K.		
☐	☐	Floor Joists - General Case / Special Case	9.23.4.2.(1); 9.23.4.4.(2); Tables A-1to A-2
☐	☐	Floor Joists	9.23.9.
☐	☐	Cantilevered Floor Joists	9.23.9.9.
☐	☐	Restraint of Joist Bottoms	9.23.9.3.(1)
☐	☐	Strapping & Bridging of Floor Joists	9.23.9.4.; Tables A-1 & A-2
☐	☐	Ceiling Required for Spans in Table A-2	9.23.9.4.(6)
☐	☐	Framing Around Floor Openings	9.23.9.5. to 9.23.9.7.(1)
☐	☐	Support of Non-Loadbearing Partitions	9.23.9.8.(1) to (3)
☐	☐	Support of Loadbearing Partitions	9.23.9.8.(4) and (5)
☐	☐	Subflooring; Materials & Installation	9.23.14.
☐	☐	Ceiling Joists Supporting Roof Load	9.23.13.10.

WALL FRAMING

NIC	O.K.		
☐	☐	Wall Studs	9.23.10.
☐	☐	Top Plates: Single/Double	9.23.11.3.
☐	☐	Wall Sheathing	9.23.16.
☐	☐	Second Plane of Protection	9.27.3.

INSULATION & VAPOUR BARRIERS

NIC	O.K.		
☐	☐	Areas to be Insulated	9.25.2.1.
☐	☐	Minimum Thermal Resistance of Insulation	SB-12*
☐	☐	Insulation: Materials & Specifications	9.25.2.2. to 9.25.2.5.
☐	☐	Ratio of Outboard to Inboard Insulation	Table 9.25.5.2.

AIR BARRIERS & VAPOUR BARRIERS

NIC	O.K.		
☐	☐	Insulation: Installation	9.25.2.3.
☐	☐	Air Barriers	9.25.3.
☐	☐	Vapour Barrier Materials	9.25.4.2.
☐	☐	Polyethylene Vapour Barrier (CAN/CGSB-51.34-M)	9.25.4.2.(3)
☐	☐	Vapour Barrier: Installation on Warm Side	9.25.4.3.(2)

Interior Finishes

WALL & CEILING FINISHES

NIC	O.K.		
☐	☐	Waterproof Finish @ Tubs & Showers / Materials	9.29.2.1.(1); 9.29.2.2.(1)
☐	☐	Wood Furring: Size & Spacing	9.29.3.; Table 9.29.3.1.
☐	☐	Metal Lath & Plaster (CSA A82.30-M)	9.29.4.1.(1)
☐	☐	Gypsum Board Finish	9.29.5.
☐	☐	Plywood Finish	9.29.6.

FLOORING

NIC	O.K.		
☐	☐	Finished Flooring: Materials & Installation	9.30.1.
☐	☐	Panel Type Underlay	9.30.2.
☐	☐	Wood Strip Flooring	9.30.3.
☐	☐	Ceramic Tile Set in Mortar Bed	9.30.6.1.(1)
☐	☐	Ceramic Tile: Reinforcement for Panel Type Sheathing	9.30.6.1.(2)

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Exterior Finishes

MASONRY AND ICF CONSTRUCTION

NIC	O.K.		
☐	☐	Masonry Materials	9.20.2.
☐	☐	Thickness / Height of Masonry Veneer	9.20.1.1.; 9.20.6.
☐	☐	Masonry Support (Concrete, Steel or Masonry)	9.20.5.1.; Table 9.20.5.2.A.
☐	☐	Lintels / Beams for Masonry Veneer Openings	Tables 9.20.5.2.B. and 9.20.5.2.C.
☐	☐	25 mm Air Space	9.20.6.4.(2)
☐	☐	Masonry Veneer Ties & Spacing	9.20.9.5.; Table 9.20.9.5.
☐	☐	Flashing	9.20.13.1. to 9.20.13.7.
☐	☐	Weep Holes (800 mm o.c. max.)	9.20.13.8.
☐	☐	Corbelling (25 mm max. for 90 mm wall thick)	9.20.12.3.
☐	☐	Corbelling (12 mm for < 90 mm wall thick)	9.20.12.3.

SIDING

NIC	O.K.		
☐	☐	Clearances (200 mm) from Ground / (50 mm) from Roof Surface	9.27.2.4.(1); 9.27.2.4.(2)
☐	☐	Flashing @ Horiz. Junctions & Wall Openings	9.27.3.8.
☐	☐	Lumber Siding	9.27.6.
☐	☐	Wood Shingle Siding	9.27.7.
☐	☐	Plywood Panels & Siding	9.27.8.
☐	☐	Hardboard Siding	9.27.9.
☐	☐	OSB & Waferboard Siding	9.27.10.
☐	☐	Metal / Vinyl Siding	9.27.11.; 9.27.12.
☐	☐	Exterior Insulation Finish System	9.27.13.
☐	☐	Stucco	9.28.

ROOFING

NIC	O.K.		
☐	☐	Adequate Roof Protection	9.26.1.1.; 9.26.1.2.
☐	☐	Roof Type Adequate for Roof Slope	9.26.3.1.; Table 9.26.3.1.
☐	☐	Valley Flashing	9.26.4.3.
☐	☐	Intersection Flashing @ Walls / Roofs	9.26.4.4.; 9.26.4.5.; 9.26.4.6.; 9.26.4.7.
☐	☐	Flashing @ Chimneys or Saddles	9.26.4.8.
☐	☐	Eave Protection for Shingles	9.26.5.
☐	☐	Asphalt Shingles	9.26.7.; 9.26.8.
☐	☐	Wood Roof Shingles	9.26.9.
☐	☐	Hand Split Roof Shakes	9.26.10.
☐	☐	Built-Up Roofs (3 Layers min.)	9.26.11.

Plumbing and Electrical Facilities

PLUMBING FACILITIES

NIC	O.K.		
☐	☐	Required Facilities: Kitchen Sink, Lavatory, Water Closet & Bathtub or Shower Stall	9.31.3.2.; 9.31.4.1.(1)
☐	☐	Laundry Space Provided	9.31.4.2.(1)
☐	☐	Floor Drain in Basement	9.31.4.4.(1)
☐	☐	Hot Water Provided	9.31.6.
☐	☐	Temperature Control for Water	Div. A 1.1.2.1.(1); 7.6.5.1.

ELECTRICAL FACILITIES

NIC	O.K.		
☐	☐	Exterior Lighting @ Entrance to Dwelling	9.34.2.1.(1)
☐	☐	Stairway Lighting with 3-Way Switch	9.34.2.3.(2) and (3)
☐	☐	Lighting in Garage	9.34.2.6.

INSPECTION CHECKLIST

PART 9 HOUSING

2012 Building Code (O. Reg. 332/12)
to Amending O. Regs. 368/13

The Purpose of this checklist is to provide assistance to Building Officials, Designers, and Builders in plans review and inspection.

This checklist is for information purposes only and does not address all the requirements in the Building Code and other applicable law.

NIC = Not In Compliance

Excavation

SOIL & SITE CONDITIONS

NIC	O.K.		
☐	☐	Verify Angle of Repose	Div C, 1.2.1.1.(1); 1.2.2.1.(4)
☐	☐	Underpinning of Existing Foundations	9.12.1.4.
☐	☐	Integrity of Excavation	9.12.1.4.(2)
☐	☐	No Organic, Frozen Material, Standing Water, or Termites	9.12.1.1. to 9.12.1.3.
☐	☐	Excavation to Undisturbed Soil	9.12.2.1.(1)
☐	☐	Foundation Depth, Frost Cover	9.12.2.2.
☐	☐	Compaction of Soil (If Required)	9.15.3.2.(1) and (2)

FOOTING FORMS & CONCRETE

NIC	O.K.		
☐	☐	Form Layout as per Approved Drawings	s.8-(13) BCA
☐	☐	Concrete	9.3.1.
☐	☐	Exterior Concrete Steps & Fireplaces	9.8.9.2.; 9.15.; 9.12.2.2.(3) and (4)
☐	☐	Fireplaces	9.22.1.3.(1); 9.15.
☐	☐	Service Trench Beneath Footing	9.12.4.1.(1)
☐	☐	Dimensions of Strip, Column & Stepped Footings	9.15.3.;Table 9.15.3.4.

SOIL & SITE CONDITIONS

NIC	O.K.		
☐	☐	No Debris or Boulders (within 600 mm of the Foundation)	9.12.3.3.(1)

DRAINAGE TILE & COVER

NIC	O.K.		
☐	☐	Footing Drain (100 mm. diameter min.)	9.14.3.2.(1)
☐	☐	Crushed Stone or Granular Cover (150 mm)	9.14.3.3.(4)

FOOTINGS

NIC	O.K.		
☐	☐	Exterior Concrete Steps & Fireplaces	9.8.9.2.; 9.12.2.2.(3) and (4)
☐	☐	Fireplaces	9.22.1.3.(1)
☐	☐	Underpining of Existing Footings	9.12.1.4.
☐	☐	Verify Footing Size & Eccentricity	9.15.3.; Table 9.15.3.4.

FOUNDATION WALLS

NIC	O.K.		
☐	☐	Cold Weather Protection	9.3.1.9.; 9.20.14.
☐	☐	Temporary Bracing Before Backfilling	9.12.3.4.(1)
☐	☐	Wall Thickness (2500 mm max. Unsupported Height)	9.15.4.2.; Tables 9.15.4.2.A. and 9.15.4.2.B.
☐	☐	Lateral Support	9.15.4.2.
☐	☐	Crack Control Joints	9.15.4.9.
☐	☐	Interior Masonry Walls	9.15.4.10.(1)
☐	☐	Top Course of Concrete Blocks Filled or Wood Sill Plate Provided for Joist Support	9.15.5.1.
☐	☐	190 mm min. Deep Solid Masonry for Beams	9.15.5.2.
☐	☐	Mortar Joints	9.20.4.
☐	☐	Anchor Bolts (12.7 mm diameter @ 2400 mm o.c.)	9.23.6.1.(2)
☐	☐	Perimeter Insulation	9.25.2.3.

DAMPPROOFING & WATERPROOFING

NIC	O.K.		
☐	☐	Hydrostatic Pressure Conditions	9.13.3.1.
☐	☐	Dampproofing of Foundation Walls	9.13.2.
☐	☐	Waterproofing of Foundation Walls	9.13.3.

NIC = Not In Compliance

Framing

COLUMNS

NIC	O.K.		
☐	☐	Columns Centered / Secured to Footing	9.17.2.1.(1); 9.17.2.2.
☐	☐	Steel Columns (73 mm diameter 4.76 mm min. Thickness)	9.17.3.1.
☐	☐	Wood Columns (184 mm diameter or 140 X 140 mm min.)	9.17.4.1.
☐	☐	Masonry / Concrete Columns	9.17.5.; 9.17.6.

BEAMS

NIC	O.K.		
☐	☐	Beams Supported on 190 mm min. Deep Solid Masonry	9.15.5.2.
☐	☐	Beam End Bearing (89 mm min.)	9.23.8.1.(1)
☐	☐	Wood Beams	9.23.4.2.(3); 9.23.8.3.; Tables A-1 to A-12
☐	☐	Glulam Floor Beams	9.23.4.2.(3); Tables A-8 to A-11
☐	☐	Steel Beams	9.23.4.3.(1); Table 9.23.4.3.

FLOOR FRAMING

NIC	O.K.		
☐	☐	Crawl Space Access (500 X 700 mm min.)	9.18.2.1.(1)
☐	☐	Floor Joists; General Case / Special Case	9.23.4.2.(2); 9.23.4.4.(2); Tables A-1 & A-2
☐	☐	Drilling / Notching	9.23.5.1.(1); 9.23.5.2.(1)
☐	☐	Joists Supported by Beams	9.23.9.2.
☐	☐	Restraint of Joist Bottoms	9.23.9.3.(1)
☐	☐	Strapping & Bridging of Floor Joists	9.23.9.4.; 9.23.9.4.(6); Tables A-1 & A-2
☐	☐	Double Joists Required / Support	9.23.9.5.; 9.23.9.6.; 9.23.9.7.
☐	☐	Blocking Between Joists (Non-Loadbearing Walls)	9.23.9.8.(1) and (2)
☐	☐	Cantilevered Floor Joists	9.23.9.9.
☐	☐	Subflooring: Materials & Installation	9.23.14.

WALL FRAMING

NIC	O.K.		
☐	☐	Wall Studs	9.23.10.; Table 9.23.10.1.
☐	☐	Double Top Plates / Single Top Plates	9.23.11.3.(1) / 9.23.11.3.(2), (3) and (4)
☐	☐	Top Plates Lapped @ Corners	9.23.11.4.(2)
☐	☐	Notching and Drilling	9.23.5.3.(1); 9.23.5.4.(1)
☐	☐	Support of Loadbearing Partitions	9.23.9.8.(4) and (5)
☐	☐	Window Opening for Light & Rescue	Table 9.7.2.3.; 9.9.10.1.
☐	☐	Percentage of Unprotected Openings Permitted in Exterior Walls	9.10.14.2.; 9.10.15.2.; Table 9.10.14.4.; Table 9.10.15.4.
☐	☐	FRR of Exterior Wall	9.10.14.5.; 9.10.15.5.; Table 9.10.14.5.
☐	☐	Percentage of Glazed Openings	9.10.15.2.; 9.10.15.4.; Table 9.10.15.4.
☐	☐	Cladding & Construction Types for Ext. Wall	9.10.14.5.; 9.10.15.5.; Table 9.10.14.5.
☐	☐	Openings in Walls with Limiting Distance Less Than 1.2 m	9.10.14.4.; 9.10.15.4.; Table 9.10.15.4.

CEILING FRAMING

NIC	O.K.		
☐	☐	Ceiling Joists	9.23.4.2.(1); Table A-3
☐	☐	Drilling / Notching	9.23.5.1.(1); 9.23.5.2.(1)

NIC = Not In Compliance

ROOF FRAMING & TRUSSES

NIC	O.K.		
☐	☐	Roof Joists	9.23.4.2.(1);Tables A-4 & A-5
☐	☐	Restraint of Joist Bottoms	9.23.13.9.(1)
☐	☐	Roof Rafters	9.23.4.2.(1); Tables A-6 & A-7
☐	☐	Collar Ties, Dwarf Walls & Struts	9.23.13.7.
☐	☐	Ridge Support, Ridge Beams	9.23.13.8.; Table A-12
☐	☐	Roof Trusses	9.23.13.11.
☐	☐	Truss Drawing by a Qualified Person	9.4.1.1.(1) and (2)
☐	☐	Notching & Drilling of Trusses	9.23.5.5.(1)
☐	☐	Vents: Evenly Distributed/ Eaves Unobstructed	9.19.1.1.(1); 9.19.1.2.(3)
☐	☐	Vent Area (1:300 min. / 1:150 Low Slope)	9.19.1.2.(1), (2)
☐	☐	Cross Purlins	9.19.1.3.

FIRE PROTECTION ROUGH-IN

NIC	O.K.		
☐	☐	Permitted Openings, &Closures	9.10.5.; 9.10.9.3.(1)
☐	☐	Electrical Boxes Tightly Fitted	9.10.5.1.(2)
☐	☐	Combustible Wiring (25 mm diameter)	9.10.9.6.(4)
☐	☐	Continuity of Fire Separation	9.10.9.2.(1)
☐	☐	Collapse of Combustible Construction	9.10.9.8.(1)
☐	☐	Fire Separation Between Dwelling Units (Semi Detached, Row houses & Townhouses)	9.10.11.2.; SB-3*

FIREPLACE ROUGH-IN

NIC	O.K.		
☐	☐	Chimney Design (12 m High max.)	9.21.1.1.
☐	☐	Factory Built Chimneys / Fireplaces	9.21.1.2.(1) / 9.22.8.1.(1)
☐	☐	Connections of More Than 1 Appliance	9.21.2.2.
☐	☐	Chimney Flue Size	9.21.2.4.; Tables 9.21.2.5.A. & 9.21.2.5.B.; 9.21.2.6.(1)
☐	☐	Chimney Lining & Installation	9.21.3.
☐	☐	Height of Chimney Flues	9.21.4.4.(1)
☐	☐	Cleanout (except Masonry Fireplace)	9.21.4.7.(1)
☐	☐	Wall Thickness (75 mm min.)	9.21.4.8.(1)
☐	☐	Clearance from Combustible Construction	9.21.5.1.
☐	☐	Supported Joists & Beams on Masonry Walls Enclosing Chimney Flues Separated by 290 mm min. Solid Masonry	9.21.5.3.(1)
☐	☐	Support of Masonry Opening	9.22.1.2.(2)
☐	☐	Liners / Firebrick / Steel	9.22.2.1.(1); 9.22.2.2.; 9.22.2.3.(1)
☐	☐	Wall Thickness	9.22.3.1.
☐	☐	Hearth Extension, Support & Clearances	9.22.5.
☐	☐	Damper	9.22.6.1.(1)
☐	☐	Smoke Chamber 45° / Thickness	9.22.7.1.(1); 9.22.7.2.(1)
☐	☐	Clearance of Combustibles to Fireplace Opening	9.22.9.1.

*SB denotes Supplementary Standards to the 2012 Building Code Compendium (Volume 2).

NIC = Not in Compliance

ABOVE GRADE MASONRY

NIC	O.K.		
☐	☐	Masonry Support	9.20.5.1.; Table 9.20.5.2.A.
☐	☐	Steel Lintel for Masonry Veneer	Tables 9.20.5.2.B. and 9.20.5.2.C.
☐	☐	Ext. Masonry, Wall Thickness & Height	9.20.6.1.
☐	☐	Int. Non-Loadbearing Walls	9.20.6.3.
☐	☐	Support of Beams & Columns	9.20.8.4.
☐	☐	Masonry Veneer Ties & Spacing	9.20.9.5.; Table 9.20.9.5.
☐	☐	Anchorage of Roofs, Floors & Intersecting Walls	9.20.11.
☐	☐	Corbelling	9.20.12.
☐	☐	Flashing	9.20.13.1. to 9.20.13.7.
☐	☐	Weep Holes (800 mm max. o.c.)	9.20.13.8.
☐	☐	Cold Weather Installation & Protection	9.20.14.

ROOFING & EAVE PROTECTION

NIC	O.K.		
☐	☐	Roof Sheathing: Materials & Installation	9.23.15.
☐	☐	Drainage for Flat Roofs	9.26.3.1.(2)
☐	☐	Flashing	9.26.4.
☐	☐	Eave Protection: Materials and Installation	9.26.5.1.(1); 9.26.5.2.(1)
☐	☐	Asphalt Shingles on Slopes 1:3 or Greater	9.26.7.
☐	☐	Asphalt Shingles on Slopes Less Than 1:3	9.26.8.
☐	☐	Built-Up Roofs (3 Layers min.)	9.26.11.
☐	☐	Cant Strip or Gravel Stop	9.26.11.10.

Insulation

AMOUNT, TYPE & INSTALLATION

NIC	O.K.		
☐	☐	Sound Transmission Rating	9.11.2.1.
☐	☐	Prevention of Blockage of Soffit Vents	9.19.1.1.(1)
☐	☐	Clearance to Insulation with Roof Joists	9.19.1.3.
☐	☐	Areas to be Insulated / Installation	9.25.2.1.; 9.25.2.4.
☐	☐	Minimum Thermal Resistance of Insulation	SB-12*
☐	☐	Insulation: Materials & Specifications	9.25.2.2.; 9.25.2.5.

AIR BARRIERS & VAPOUR BARRIERS

NIC	O.K.		
☐	☐	Installation of Insulation	9.25.2.3.; 9.25.2.4.; 9.25.2.5.
☐	☐	Air Barrier Materials, Check Location	9.25.3.
☐	☐	Installation of Air Barrier System	9.25.3.3.
☐	☐	Vapour Barrier Materials	9.25.4.2.
☐	☐	Polyethylene Vapour Barrier (CAN/CGSB-51.34-M)	9.25.4.2.(4)
☐	☐	Installation of Vapour Barrier	9.25.4.3.

*SB denotes Supplementary Standards to the 2012 Building Code Compendium (Volume 2).

NIC = Not In Compliance

Final Interior

STAIRS, HANDRAILS & GUARDS

NIC	O.K.		
☐	☐	Uniform Treads & Risers	9.8.4.1.
☐	☐	Step Dimensions: Rise, Run, Tread Width / Nosing	9.8.4.
☐	☐	Interior Stairway Width	9.8.2.1.(1)
☐	☐	Headroom Clearance (1950 mm min.)	9.8.2.2.(1)(b)(i)
☐	☐	Curved Stairs / Winders	9.8.4.4.; 9.8.4.5.
☐	☐	Continuous Handrail	9.8.7.2.(2)
☐	☐	Handrail Height (800 to 965 mm)	9.8.7.4.(2) and (3)
☐	☐	Handrail Clearance (50 mm min.)	9.8.7.5.(1)
☐	☐	No Obstructions on Handrail	9.8.7.5.(2)
☐	☐	Handrail Projection (100 mm max.)	9.8.7.6.(1)
☐	☐	Guard Height [on Stairs 900 mm min. / on Landings & Other Locations (1070 mm or 900 mm)	9.8.8.3.(4); 9.8.8.3.
☐	☐	Maximum Opening in Guards (100 mm)	9.8.8.5.

LANDINGS

NIC	O.K.		
☐	☐	Landing Dimensions for Int. & Ext. Stairs	9.8.6.3.; Table 9.8.6.3.
☐	☐	Required Landings	9.8.6.2.
☐	☐	Vertical Height Between Landings (3.7 m max.)	9.8.3.3.
☐	☐	Headroom Clearance	9.8.6.4.

WALL, CEILING & FLOOR FINISHES

NIC	O.K.		
☐	☐	Max. 150 Flame-Spread Rating (FSR)	9.10.17.1.(1)
☐	☐	Waterproof Finish @ Bathtubs & Showers	9.29.2.1.(1)
☐	☐	Finished Flooring	9.30.1.

DOORS

NIC	O.K.		
☐	☐	Required @ Entrance & Washroom	9.7.2.1.(1)
☐	☐	Exterior Doors	9.7.3.; 9.7.4.; 9.7.5.
☐	☐	Weatherstripping	9.7.3.1.
☐	☐	Mirrored Glass Doors	9.6.1.2.(2) and (3)
☐	☐	Glass for Showers or Bathtub Enclosures	9.6.1.4.(6)
☐	☐	Resistance to Forced Entry	9.7.5.2.

WINDOWS

NIC	O.K.		
☐	☐	Openable Windows > 0.35 m^2 on Floor Level Containing Bedrooms	9.9.10.1.
☐	☐	Resistance to Forced Entry Within 2 m of Adjacent Ground (CAN/CSA-A440 Clause 10.13)	9.7.5.3.
☐	☐	Natural Ventilation	9.32.2.1.; Table 9.32.2.1.

NIC = Not In Compliance

FIRE PROTECTION

NIC	O.K.		
☐	☐	Continuity of Fire Separation (Roof Space)	9.10.9.2.(1); 9.10.9.6.
☐	☐	Fire Separation with 1 h FRR Between Dwelling Units	9.10.11.2.; SB-3*
☐	☐	Door Between Garage and Dwelling Unit: Self-Closing Device / Barrier to Fumes	9.10.13.15.
☐	☐	Wall Between Garage and Dwelling Unit	9.10.9.16.(4)
☐	☐	Smoke Alarms on Each Floor Level, Between Sleeping & Living Quarters, and in Each Sleeping Room	9.10.19.1.; 9.10.19.3.
☐	☐	Visual Signalling of Smoke Alarms	9.10.19.3.(3) as of January 1 ,2015
☐	☐	Fireplace Completion, Clearances, Damper Firebrick or Liner, Combustion Air Supply	9.22.

ELECTRICAL

NIC	O.K.		
☐	☐	Stairway Lighting with 3-Way Switch	9.34.2.3.(2) and (3)
☐	☐	Lighting in Storage Rooms / Garage	9.34.2.5.; 9.34.2.6.

BASEMENTS

NIC	O.K.		
☐	☐	Covering of Foam Insulation	9.10.17.10.
☐	☐	Restraint of Joist Bottoms	9.23.9.3.; 9.23.9.4.
☐	☐	Framing Around Openings / Support of Tail & Header Joists	9.23.9.5.; 9.23.9.6.; 9.23.9.7.(1)
☐	☐	Insulated Foundation Walls	SB-12*
☐	☐	Floor Drain	9.31.4.4.

Final Exterior

LOT DRAINAGE

NIC	O.K.		
☐	☐	Surface Drainage, Slope From Foundation	9.14.6.1.(1)
☐	☐	Catch Basin @ Sunken Garage	9.14.6.4.(1)
☐	☐	Down Spout With Pad or Connected to Sewer	9.14.6.5.(1); 9.26.18.2.
☐	☐	Top of Foundation Wall (150 mm min. Above Finished Grade)	9.15.4.6.

* SB denotes Supplementary Standards to the 2012 Building Code Compendium (Volume 2).

NIC = Not In Compliance

EXTERIOR STAIRS, LANDINGS, HANDRAILS & GUARDS

NIC	O.K.		
☐	☐	Rise and Run Geometry	9.8.3.1.(1)
☐	☐	Landing @ Front Entrance	9.8.6.2.
☐	☐	Landing Required @ Secondary Entrance if Stairs have More Than 3 Risers	9.8.6.2.(3)
☐	☐	Pedestrian Ramp (1:10 max. Gradient)	9.8.5.4.(1)(a) and (b)
☐	☐	One Handrail for Stairs With More Than 3 Risers for a Single Dwelling Unit	9.8.7.1.(3)
☐	☐	Provide Guards for Landings, Balconies, etc. > 600 mm Above Adjacent Ground Level	9.8.8.1.(1)
☐	☐	Guards on Exterior Stairs > 6 Risers and Difference in Elevation > 600 mm.	9.8.8.1.(1)
☐	☐	Min. 1070 mm Guard Where Difference in Elevation > 1.8 m.	9.8.8.3.(1)
☐	☐	Min. 900 mm Guard Where Difference in Elevation of Landing, Porch < 1.8 m	9.8.8.3.(3)
☐	☐	Max. 100 mm Openings in Guards	9.8.8.5.(1)
☐	☐	Guard Designed to Prevent Climbing Between 140 mm and 900 mm.	9.8.8.6.(1)
☐	☐	Wood Stairs Treated to Prevent Decay	9.8.9.3.(1)
☐	☐	Wooden Stair Stringers (38 X 235 mm min.)	9.8.9.4.

CLADDING, CAULKING & FLASHING

NIC	O.K.		
☐	☐	45 min. FRR for Ext. Wall with a Limiting Distance 0.6 m.	9.10.14.5.(2) and (3); 9.10.15.5.
☐	☐	Masonry Support	9.20.5.
☐	☐	Flashing Over Parapets & @ Openings	9.20.13.3.
☐	☐	Flashing @ Horizontal Junctions & Over Exterior Wall Openings	9.27.3.8.
☐	☐	Intersection Flashing @ Shingles, Roofs, and Masonry	9.26.4.4.
☐	☐	Cladding Clearances (200 mm min. From Ground/ 50 mm min. From Roof Surface)	9.27.2.4.(1) and (2)
☐	☐	Caulking to Prevent Entry of Rain	9.27.4.

ROOFING & VENTING

NIC	O.K.		
☐	☐	Roof Venting	9.19.1.
☐	☐	Chimney Cap / Cleanout	9.21.4.6.; 9.26.4.7.(1)
☐	☐	Roof Type Adequate for Roof Slope	9.26.3.1.; Table 9.26.3.1.

FORMS

Application for a Permit to Construct or Demolish

This form is authorized under subsection 8(1.1) of the *Building Code Act, 1992*

For use by Principal Authority	
Application number:	Permit number (if different):
Date received:	Roll number:

Application submitted to: ______________________________
(Name of municipality, upper-tier municipality, board of health or conservation authority)

A. Project information

Building number, street name		Unit number	Lot/con.
Municipality	Postal code	Plan number/other description	
Project value est. $		Area of work (m^2)	

B. Purpose of application

☐ New construction ☐ Addition to an existing building ☐ Alteration/repair ☐ Demolition ☐ Conditional Permit

Proposed use of building	Current use of building
Description of proposed work	

C. Applicant

Applicant is: ☐ Owner or ☐ Authorized agent of owner

Last name	First name	Corporation or partnership	
Street address		Unit number	Lot/con.
Municipality	Postal code	Province	E-mail
Telephone number ( )	Fax ( )		Cell number ( )

D. Owner (if different from applicant)

Last name	First name	Corporation or partnership	
Street address		Unit number	Lot/con.
Municipality	Postal code	Province	E-mail
Telephone number ( )	Fax ( )		Cell number ( )

Application for a Permit to Construct or Demolish – Effective January 1, 2014

E. Builder (optional)				
Last name	First name	Corporation or partnership (if applicable)		
Street address			Unit number	Lot/con.
Municipality	Postal code	Province	E-mail	
Telephone number ( )	Fax ( )		Cell number ( )	

F. TARION Warranty Corporation (Ontario New Home Warranty Program)		
i. Is proposed construction for a new home as defined in the *Ontario New Home Warranties Plan Act*? If no, go to section G.	☐ Yes	☐ No
ii. Is registration required under the *Ontario New Home Warranties Plan Act*?	☐ Yes	☐ No
iii. If yes to (ii) provide registration number(s): ____________________		

G. Required Schedules
i) Attach Schedule 1 for each individual who reviews and takes responsibility for design activities.
ii) Attach Schedule 2 where application is to construct on-site, install or repair a sewage system.

H. Completeness and compliance with applicable law		
i) This application meets all the requirements of clauses 1.3.1.3 (5) (a) to (d) of Division C of the Building Code (the application is made in the correct form and by the owner or authorized agent, all applicable fields have been completed on the application and required schedules, and all required schedules are submitted).	☐ Yes	☐ No
Payment has been made of all fees that are required, under the applicable by-law, resolution or regulation made under clause 7(1)(c) of the *Building Code Act, 1992*, to be paid when the application is made.	☐ Yes	☐ No
ii) This application is accompanied by the plans and specifications prescribed by the applicable by-law, resolution or regulation made under clause 7(1)(b) of the *Building Code Act, 1992*.	☐ Yes	☐ No
iii) This application is accompanied by the information and documents prescribed by the applicable by-law, resolution or regulation made under clause 7(1)(b) of the *Building Code Act, 1992* which enable the chief building official to determine whether the proposed building, construction or demolition will contravene any applicable law.	☐ Yes	☐ No
iv) The proposed building, construction or demolition will not contravene any applicable law.	☐ Yes	☐ No

I. Declaration of applicant

I ____ declare that:
(print name)

1. The information contained in this application, attached schedules, attached plans and specifications, and other attached documentation is true to the best of my knowledge.
2. If the owner is a corporation or partnership, I have the authority to bind the corporation or partnership.

______________________ ______________________________________

Date Signature of applicant

Personal information contained in this form and schedules is collected under the authority of subsection 8(1.1) of the *Building Code Act, 1992*, and will be used in the administration and enforcement of the *Building Code Act, 1992*. Questions about the collection of personal information may be addressed to: a) the Chief Building Official of the municipality or upper-tier municipality to which this application is being made, or, b) the inspector having the powers and duties of a chief building official in relation to sewage systems or plumbing for an upper-tier municipality, board of health or conservation authority to whom this application is made, or, c) Director, Building and Development Branch, Ministry of Municipal Affairs and Housing 777 Bay St., 2nd Floor. Toronto, M5G 2E5 (416) 585-6666.

Schedule 1: Designer Information

Use one form for each individual who reviews and takes responsibility for design activities with respect to the project.

A. Project Information

Building number, street name			Unit no.	Lot/con.
Municipality	Postal code	Plan number/ other description		

B. Individual who reviews and takes responsibility for design activities

Name		Firm		
Street address			Unit no.	Lot/con.
Municipality	Postal code	Province	E-mail	
Telephone number ( )	Fax number ( )		Cell number ( )	

C. Design activities undertaken by individual identified in Section B. [Building Code Table 3.5.2.1. of Division C]

☐ House	☐ HVAC – House	☐ Building Structural
☐ Small Buildings	☐ Building Services	☐ Plumbing – House
☐ Large Buildings	☐ Detection, Lighting and Power	☐ Plumbing – All Buildings
☐ Complex Buildings	☐ Fire Protection	☐ On-site Sewage Systems

Description of designer's work

D. Declaration of Designer

I ______________________________ declare that (choose one as appropriate):
(print name)

I review and take responsibility for the design work on behalf of a firm registered under subsection 3.2.4.of Division C, of the Building Code. I am qualified, and the firm is registered, in the appropriate classes/categories.

Individual BCIN: ____________________

Firm BCIN: ____________________

I review and take responsibility for the design and am qualified in the appropriate category as an "other designer" under subsection 3.2.5.of Division C, of the Building Code.

Individual BCIN: ____________________

Basis for exemption from registration: ____________________

The design work is exempt from the registration and qualification requirements of the Building Code.
Basis for exemption from registration and qualification: ____________________

I certify that:

1. The information contained in this schedule is true to the best of my knowledge.
2. I have submitted this application with the knowledge and consent of the firm.

Date ____________________ Signature of Designer ____________________

NOTE:

1. For the purposes of this form, "individual" means the "person" referred to in Clause 3.2.4.7(1) (c).of Division C, Article 3.2.5.1. of Division C, and all other persons who are exempt from qualification under Subsections 3.2.4. and 3.2.5. of Division C.
2. Schedule 1 is not required to be completed by a holder of a license, temporary license, or a certificate of practice, issued by the Ontario Association of Architects. Schedule 1 is also not required to be completed by a holder of a license to practise, a limited license to practise, or a certificate of authorization, issued by the Association of Professional Engineers of Ontario.

Schedule 2: Sewage System Installer Information

A. Project Information				
Building number, street name			Unit number	Lot/con.
Municipality	Postal code	Plan number/ other description		
B. Sewage system installer				
Is the installer of the sewage system engaged in the business of constructing on-site, installing, repairing, servicing, cleaning or emptying sewage systems, in accordance with Building Code Article 3.3.1.1, Division C? ☐ Yes (Continue to Section C) ☐ No (Continue to Section E) ☐ Installer unknown at time of application (Continue to Section E)				
C. Registered installer information (where answer to B is "Yes")				
Name			BCIN	
Street address			Unit number	Lot/con.
Municipality	Postal code	Province	E-mail	
Telephone number ( )	Fax ( )		Cell number ( )	
D. Qualified supervisor information (where answer to section B is "Yes")				
Name of qualified supervisor(s)		Building Code Identification Number (BCIN)		
E. Declaration of Applicant:				

I ______________________________ declare that:
(print name)

I am the applicant for the permit to construct the sewage system. If the installer is unknown at time of application, I shall submit a new Schedule 2 prior to construction when the installer is known;

OR

I am the holder of the permit to construct the sewage system, and am submitting a new Schedule 2, now that the installer is known.

I certify that:

1. The information contained in this schedule is true to the best of my knowledge.
2. If the owner is a corporation or partnership, I have the authority to bind the corporation or partnership.

______________ ______________________________

Date Signature of applicant

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Construction Guide for Housing

G

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